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PREFACE

This book has been prepared to bring together, in a form accessible for class use, scattered articles and selections upon the subject of business statistics. It is designed primarily for purposes of instruction in the course in Business Statistics in the Harvard Graduate School of Business Administration. The subject is one to which scientific attention has only recently been directed; consequently there is a dearth of published material which is strictly scientific. For this reason some selections have been included which are not fully satisfactory but which suggestively furnish a basis for class discussion. The inclusion of any selection does not imply that the methods used or the conclusions reached meet with the editor's full approval.

Business statistics, it may be stated, are numerical statements of facts, exclusive of financial accounts, which are used in business administration. These statistics are of two general classes — (1) external statistics, generally publicly available, which indicate the general trend of business and market conditions, and (2) internal statistics, which are concerned with the private operations of an individual business establishment. Examples of the first class are the statistics of manufactures, agriculture, and population collected by the United States Bureau of the Census, railroad and other public utility statistics published by the Interstate Commerce Commission and by state commissions, banking and financial statistics published in the financial journals, price and production statistics published in trade papers, and the reports of trade associations. Internal statistics include those obtained from the sales, advertising, and factory reports of an individual firm or company. Such reports and records are used in business establishments of all sorts, both large and small. In fact successful business administration depends to a large degree upon these reports and records, which are utilized for checking up current

operations and determining tendencies. They provide a basis for the formulation of plans and policies. If all of the details of the business are to be followed accurately and if exact standards are to be established for comparison, such records are indispensable.

In some large manufacturing companies an elaborate statistical system is maintained, whereby the various department heads obtain statistical reports for their own guidance and summaries of these departmental reports are prepared at regular intervals for the chief executive. By this means statistics are gathered from all corners of the organization, covering all of its activities. These current reports are supplemented by reports on special tests or investigations. The use of statistics is not confined, however, to large companies; many small manufacturing establishments and numerous retail stores of ordinary volume of business utilize statistical records to advantage. The articles which are reprinted in this book have been selected with a view to illustrating the uses of these various kinds of statistics and the methods of collection and presentation in both large and small businesses.

This book does not pretend to cover the entire field of business statistics, but deals chiefly with statistics used in mercantile and manufacturing businesses. Financial and foreign trade statistics have not been included, except for casual references, since the articles and other publications on those subjects are usually more readily available than the scattered articles on mercantile and manufacturing statistics and the space limitations of this volume do not permit of expansion. Lack of space has also made it impossible to include more articles on statistics used in the administration of railroads, local public service companies, banks, and insurance companies. Although their application to these specialized subjects is given scanty consideration here, the same fundamental principles of statistical theory and method apply to these special classes of business statistics.

In presenting statistics to be used in business administration, graphs and charts can frequently be used advantageously to supplement tabulated figures. Many persons can more readily grasp the facts shown by the statistics when they are presented in

graphical form. It must be recognized, nevertheless, that others prefer to use only the tabular statements and for them it is a waste of time to prepare charts. The applications of the graphic method to the presentation of business statistics are manifold and numerous examples are shown in the selections reprinted in this book. A comprehensive treatment of the subject of chart preparation has not been included inasmuch as that subject is well covered in other treatises which are readily available.

The editor realizes fully that this work represents only a beginning of the development of this subject. He has been forced, however, to utilize such material as is available, with its numerous shortcomings and deficiencies. It is hoped that the book will serve to illustrate the magnitude of the problems involved and thereby stimulate more scientific investigation of the subject.

MELVIN T. COPELAND.

CAMBRIDGE, MASS., April 6, 1916.

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BUSINESS STATISTICS

CHAPTER I

STATISTICAL METHODS

I. Statistical Methods

By Melvin T. Copeland

It is the purpose of this chapter to explain the fundamental principles of statistical theory and method which should be observed in the collection, classification, and presentation of statistics to be utilized in business administration. Although only a means to an end, reliable statistics furnish one of the essential bases for the formulation of administrative policies. The solution of many a managerial problem in a business establishment is found by a study of the statistical records of past experience and present operations. The statistics, to be sure, seldom furnish all of the necessary information for the solution of a problem or the determination of a policy, but they generally provide a more definite knowledge of pertinent facts than can otherwise be obtained. Statistical records and reports help to eliminate guess work and obviate the necessity of placing reliance upon impressions or recollections which may be partial or faulty. In collecting, classifying, summarizing, and presenting these statistics, which are so useful when properly prepared, it is necessary to adhere closely to sound principles of statistical theory and method.

Statistics may be defined as numerical statements of facts by means of which large aggregates are analyzed, the relations of individual units to their groups are ascertained, comparisons are made between groups, and continuous records are maintained for comparative purposes. From this definition it is to be noted that statistics represent *facts*, expressed numerically. Secondly, statistics deal with aggregates or masses which are sufficiently large to reveal types or standards, even if individual units show wide

variations. This tendency for large aggregates or groups to conform to definite types or standards or to show general or underlying tendencies is what is meant by the " law of averages," a term with which many business men are familiar. Statistics, finally, are used chiefly for purposes of comparison. Individual units or classes are compared with the entire group of which they are a part; different groups are compared; and comparisons are made for a single group at different periods of time in order to reveal tendencies.

One of the chief sources of statistical data in a factory, for example, is the cards or forms upon which the performance of each workman is recorded. These cards may serve primarily for making out the payroll, a purpose for which each is used individually. If that is the only use which is made of the data on the cards, they are not to be considered as statistics. The data on the cards serve a statistical purpose only when the records for each group of workmen are combined or a comparative record is compiled in such form that exact comparisons can be made. Similarly in a department store, in order to provide a check on errors, a record may be kept of each package delivered, but if the total number delivered is not computed periodically, the store has no delivery statistics. It is the use of such reports and memoranda for statistical purposes with which we are concerned in this book; the other purposes for which the original data may be used need not be discussed here. This chapter is concerned with the principles involved in the collection, classification, and presentation of business statistics, both external and internal.

The planning of a schedule of questions or a system of reports, by means of which statistics are to be collected, is the first topic to be considered and it is one of great importance. The value of any statistics depends to a large degree upon the accuracy with which the original data are collected. Conclusions drawn from the statistics cannot be reliable if there are inaccuracies in the original data. In order that errors may be prevented, each question on a schedule should be stated so simply and so directly that indefinite or ambiguous answers are impossible. Thus a question which asks " To what extent " seldom yields usable answers.

Each question, furthermore, should be phrased so as to avoid suggesting that the investigator has any personal interest in the results shown or that any particular answer is expected or hoped for; otherwise the replies are likely to be biased. The number of questions to be included should be as small as is consistent with the purpose of the inquiry. Ordinarily it is an easy matter to expand the list of questions to include many which might in themselves be interesting but which would not have sufficient practical value to warrant their inclusion.

These requirements have been well stated by A. L. Bowley, the well-known English statistician, as follows:[1]

"The questions must be so clear that a misunderstanding is impossible, and so framed that the answers will be perfectly definite, a simple number, or 'yes' or 'no.' They must be such as cannot give offence, or appear inquisitorial, or lead to partisan answers, or suppression of part of the facts. The mean must be found between asking more than will be readily answered and less than is wanted for the purpose in hand. The form must contain necessary instructions, making mistakes difficult, but must not be too complex. The exact degree of accuracy required, whether the answers are to be correct to shillings or pence, to months or days, must be decided. Every word, every square inch of space must be keenly criticised. A little trouble spent upon the form will save much inconvenience afterwards."

This statement will hold, without qualification, whether the forms are being prepared for a single, casual investigation or are for constant use in any department of a business establishment.

The schedule shown on the following page, in reduced size, was used by the United States Bureau of the Census for taking the census of population in 1910. It states clearly and explicitly the questions to which answers were desired. Each enumerator, furthermore, was provided with a set of comprehensive instructions regarding method of procedure and form in which answers should be entered, together with supplementary definitions of terms and questions.

[1] A. L. Bowley, *Elements of Statistics*, 3d ed., p. 18.

As another example, the following specimen schedule used by the Massachusetts Bureau of Statistics in a special inquiry is reproduced. The italicized entries represent answers from a typical factory.

RATES OF WAGES, EARNINGS, AND HOURS OF LABOR

1. Industry, *Paper and Wood Pulp.*
2. Specific Product, *Writing — linen, bond, and ledger.*
3. Number of employees when running full time during week ending .... 1912.

	Men	Women	Minors — Under 16: Boys	Minors — Under 16: Girls	Totals
(*a*) Dayworkers	*63*	*19*	..	..	*82*
(*b*) Shiftworkers	*80*	..	..	..	*80*
(*c*) Pieceworkers	..	*15*	..	..	*15*
Totals...........	*143*	*34*	..	..	*177*

4. Working hours of dayworkers. Total hours a week, *males, 55; females, 54.*
   (*a*) Full days, *7* A.M. to *6* P.M., *60* minutes for lunch.
   (*b*) Saturdays, *7* A.M. to *12* M., *0* minutes for lunch.

4a. Working hours of shiftworkers. Total hours mill is in operation, *144.* Total hours closed, *24.* Total hours per week, *168.* First shift begins *7* A.M., ends *3* P.M.; second shift begins *3* P.M., ends *11* P.M.; third shift begins *11* P.M., ends *7* A.M. Number of hours a week shiftworkers are relieved from work for meals, *None.*

5. Wages and hours of timeworkers for week ending October 5, 1912; of pieceworkers for weeks ending September 28, October 5, and October 12, 1912.

Department and Occupation	Time-workers (T), Shift-workers (S), or Piece-workers (P)	Number of Employees: Men	Number of Employees: Women	Number of Employees: Minors: Boys	Number of Employees: Minors: Girls	Full Time: Days per Week	Full Time: Hours: Day	Full Time: Hours: Week	Actual Time Made and Earnings in Week Oct. 5, 1912: Hours Worked	Actual Time Made and Earnings in Week Oct. 5, 1912: Earnings	Rate of Pay per[1]
Machine tender	*S*	*1*	..	..	..	*6*	*8*	*48*	*48*	*$28.00*	*58½c. hr.*
Machine tender	*S*	*1*	..	..	..	*6*	*8*	*48*	*40*	*23.20*	*58½c. hr.*
Machine tender	*S*	*1*	..	..	..	*6*	*8*	*48*	*56*	*29.75*	*53.1c. hr.*
Size maker....	*T*	*1*	..	..	..	*6*	*10*	*55*	*55*	*10.50*	*19 c. hr.*
									36	*5.25*	
Rag sorter	*P*	..	*1*	..	..	*6*	*9*	*54*	*27*	*3.40*	*Piece*
									45	*5.50*	

[1] Insert here the unit of payment.

The following form [1] is used by the Boston Placement Bureau for obtaining information regarding employers with whom the Bureau may secure suitable positions for young people just entering commercial and industrial life from the public schools of Boston. The Bureau aims " to bring the right worker and work together by seeking to know as much as possible about the requirements of both." This " Firm Schedule " is an excellent example of a form which is carefully planned to record a maximum amount of definite information with economy of space.

NAME OF FIRM.. | Industry..
Address.. | Product..
Employment Manager.................................... | ....

Kinds of Work	No.	Sex	Age	Weekly Wages			Time-work	Piece-work	Position		Remarks Dangers
				Begin	Rate Inc.	Max.			Sit	Stand	

EMPLOYEES: No. over 21: Men...... Women...... Under 21: Boys...... Girls...... Total.......
WORKERS DESIRED: Minimum Age.... Schooling........... Other Qualifications................
Immigrants... Negroes... Paroled Boys and Girls..... Physically Handicapped.... Probationers....
SEASONS: Rush.......... Maximum Force.......... Dull.......... Minimum Force............
HOURS: Begin...... A.M. End...... P.M. Saturday...... P.M. Noon...... Variation...........
PHYSICAL CONDITIONS: Type Building............... Light............ Ventilation..............
Space.............. Cleanliness.............. Lunch Facilities.......................
Fire Protection................................ Rest Room......................
OPPORTUNITIES FOR ADVANCEMENT..
Co-operation with Placement Bureau...
Present Wants...
Date.............................. Reported by......................................

Form 3. Firm Schedule. Placement Bureau.

Manufacturers and wholesalers who employ traveling salesmen can utilize the salesmen to collect valuable information, at least partially statistical in nature, concerning business conditions in the districts which the salesmen visit. One company, which has frequently used its large salesforce for this purpose, sent out the following questionnaire to its salesmen in 1910:

[1] Reproduced by permission. The size of the original card is 5x8 inches.

1. Are automobiles being bought freely in your territory? ....
2. Are they being bought for cash?............; or on credit?..............
3. Are purchasers mortgaging land or homes to buy automobiles?......................; to what extent?......................
4. Are purchasers withdrawing money from banks?...................
5. When not cash, are terms partly cash and partly credit? ....; how long credit?......................
6. What class of men constitute the largest class of purchasers?....................
7. What is the attitude of bankers and financial men toward the whole question?......................
8. Do they anticipate any serious difficulty or financial happening because of extensive purchases of automobiles? ....
9. Are automobiles being used for purposes other than pleasure?.............................
10. How have automobile purchases affected the retail hardware trade?............................; the lines carried?..............................
11. Do purchasers of automobiles settle their accounts with retail hardware dealers as promptly as heretofore?................
12. How has the purchase of automobiles affected good roads sentiment, especially amongst farmers?......................

The replies to these questions were summarized and they gave the company more definite knowledge concerning the conditions in individual localities and also concerning general tendencies than could be obtained elsewhere. The conclusions which were drawn from the summary of the replies have proved to be correct. The possibilities of this method of obtaining information of high value have been appreciated by only a few of the companies which are in a position to avail themselves of it. In drawing up a questionnaire for such a purpose as this the general rules which have been stated should be observed.

The following questions from the Schedule for Retail Grocers used by the Harvard Bureau of Business Research in its study of the retail grocery trade illustrate a form of specific question for the collection of information partially statistical in character.

Instead of asking: "Do you employ any system of stock records? .... What does this system show? ....," the question is:

> "Do you employ any system of stock records? .... Does it show for each line and brand — the quantity received? ....; quantity on hand? ....; quantity sold? ....; quantity ordered? ....; quantity to buy? ....; source of supply? ....; dates to buy? ....; percentage of profit? ....; or any other information? .... Is this information obtained from sales slips? ....; or how? .... For what period is the record kept? .... What is your method of following the movement of new brands, slow movers, and specialties? ...."

The other questions upon the schedule are similarly specific.

So far we have been considering chiefly the collection of external statistics. Somewhat different conditions are found when the collection of internal statistics within a single business establishment is undertaken. Internal statistics are kept largely in the form of continuous records made up from reports received at regular intervals.[1] Individual employees or officers are made personally responsible for the accuracy and punctuality of the reports. This tends to prevent errors, but does not eliminate them entirely; the forms used may be imperfectly understood by the person who is expected to fill them out. As in a schedule or form for the collection of external statistics, each item called for on these internal reports should be indicated definitely and specifically in simple terms. Any term which is ambiguous or possible of more than one interpretation should be avoided.

These internal records not only serve as a means of recording data for tabulation but also are used for reference purposes. The exact form which is chosen, therefore, must meet both these needs. In planning a set of records the primary basis of classification must be determined first, since the records will be filed upon that basis. Take the purchasing department of a factory

[1] Some forms for sales, advertising, and factory records are given in the later sections of this book.

for example. A tabular record is to be kept of the orders of each material purchased. Two bases of classification are possible, — (1) according to materials, or (2) according to sources from which purchased. If the former basis is used, a card will be made out for each material and all orders of each material will be entered on a single card. If the second basis is chosen, a card will be made out for each source of supply from which purchases are made and all purchases from one source, whether or not several different materials are included, will be entered on one card. This latter method will show the total purchases from each source but not the total purchases of each material without retabulation. Inasmuch as the statistics for the total purchases of each material are generally of greater significance than the statistics for the total purchases from each source, the classification according to materials is preferred. The form of card drawn up for this purpose is shown below. The totals derived periodically from column four provide statistics of the rate of purchase for the guidance of the purchasing agent.

MATERIAL SPECIFICATIONS				TIME REQUIRED FOR DELIVERY				
Date Ordered	Date Received	Source	Quantity	Terms	Billed Cost	Net Cost	Net Cost per Unit	Claims and Allowances
TOTAL QUANTITY				PERIOD				

Form for purchase records

In such a case as the above, an attempt is sometimes made to use a composite record which will give on a single card totals for materials and totals for sources. This is generally impracticable,

however, since the record then becomes cumbersome. It is simpler to make out two sets of cards if both of these totals are required. Memoranda regarding sources, shipping instructions, and similar items should be entered on the back of the card or in some other place rather than in the columns on the face of the card. These columns should be used only for entries of facts which are peculiar to the individual order and which are subject to frequent change. These rules are of general applicability.

In planning a statistical investigation or a system of records, one of the chief problems is the selection and definition of units. The differences in the worth of various types of units are explained at length in the article by Mr. Watkins reprinted in this volume; hence, it is unnecessary to go into the subject at length here. A few examples will suffice.

Units in common use frequently have several meanings. A "case" of shoes has no standardized definition which is universally accepted. A "ton" has numerous meanings, — the long ton, the short ton, the metric ton, and also the various definitions given the term in measuring ships. Again, a unit which is sufficiently definite for some purposes may be inadequate for others. In retail shoe stores in large cities, for example, in addition to the regular salesforce, extra salesmen frequently are employed two or three evenings each week. An inquiry which showed the total number of clerks employed in these stores, including extras, would suffice if it were desired merely to learn the total number of persons gaining all or part of their livelihood from the retail shoe business. But if the object of the inquiry is to establish standards of performance, such as the average sales per salesperson, allowance must be made for the fact that the extra salespersons work only part of the time that the stores are open; the extra salesmen must be counted as fractional parts of regular salesmen or the records for all salespersons, both extras and regulars, expressed in terms of "clerk-hours." In factories and offices the "machine-hour" and the "man-hour" are often used as units for statistical purposes. Where such units are desired, provision must be made for obtaining the necessary data on the reports.

Because of the difficulties of definition, certain statistics which are collected and published in the United States Census of Manufactures are worthless or must be used with extreme caution. In the statistics for the total value of products for the various industries there is frequently serious duplication, due to the fact that the total for an industry may include figures from plants which manufacture intermediate products for sale as well as figures from plants which manufacture only fully finished goods. The intermediate products are sold as materials to plants manufacturing finished goods. If the intermediate products are produced in a plant, however, in which the final stages of the manufacturing processes of the industry are also carried on, their value is not separately reported. Hence the greater the specialization of process in independent plants, the greater the separation of the successive stages of manufacturing, the greater is the value of products reported for the industry and the greater the duplication. If there is a strong tendency toward integration of an industry, on the contrary, the duplication of returns is thereby lessened. In making comparisons of the value of products of different industries or for a single industry at different censuses, this tendency toward specialization or integration of processes must be taken into account.

As an example of this duplication, if a company manufactures pig iron for sale, the value of the pig iron sold is included in the value of product of iron and steel manufactures. Another company, however, which produces pig iron, converts this pig iron into steel, and rolls the steel into rails or other finished products, does not report the value of its pig iron production but only the value of the rails and other finished products. In the worsted industry, to give another example, as the practice of producing tops for sale increases, the reported value of the total product is increased even if no more cloth is produced.

The statistics of capital are probably the most nearly worthless of any in the Census. The Census Bureau itself condemns the statistics for capital, which by the Congressional Census Act it has been required to collect. "In the inquiry concerning capital, comparisons have no real statistical value prior to the Census of

1890. The form of the inquiry regarding capital, in all censuses down to and including 1880, was so vague and general in its character that it cannot be assumed that any true proportion exists between the statistics on this subject, as elicited prior to 1890. At the Census of 1880, the question read: 'Capital (real and personal invested in the business) $........' At the Census of 1890, live capital, i. e., cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in the process of manufacture, finished product on hand, and other sundries, was for the first time included as a separate distinct item of capital."[1] Again it is stated:[2] "The attempt to measure capital absolutely and accurately has never yet been successful in a Census in the United States or elsewhere," and the statement made by General Walker in the Ninth Census report is quoted approvingly: "The Census returns of capital invested in manufactures are entirely untrustworthy and delusive.... The results are and must remain wholly worthless." In the Census of 1910 it is stated:[3] "For reasons stated in reports of prior censuses the statistics of capital secured by the census canvass are so defective as to be of little value, except as indicating very general conditions." As a matter of fact, they are not useful for that purpose, since the same general conclusions can be drawn more safely from other Census statistics.

The difficulties in defining capital satisfactorily for Census purposes have been insuperable heretofore and will remain so until accounting methods in manufacturing plants have been standardized. The value of the land may be dependent upon its use as a factory site. The value of rented property may be included, but if so upon what basis is it to be capitalized? Some companies have charged off no depreciation but carry machinery and other plant equipment on their books at original cost. Others have written off so much that the book values of their plants are only nominal. So long as there are such variations in the practice of accounting for depreciation, how can statistics for capital, which

[1] *Twelfth U. S. Census*, vol. vii, p. lxi.
[2] *Ibid.*, p. xcvii.
[3] *Thirteenth U. S. Census, Abstract*, p. 437.

are based upon book value, be accepted as reliable? Are outside investments, in other manufacturing or financial enterprises, to be included? Are good will, patents, and trade-marks to be capitalized? Finally, is credit to be taken into account as has been done since 1890, by having unpaid accounts which are due returned as capital? The obstacles to securing reliable capital statistics are insuperable with the prevailing diversity of accounting methods. For the same reason the Census statistics for costs and expenses are now of little value. A standardization of accounting methods, which is also desirable for purely business reasons, would go far toward making the Census of Manufactures not merely an interesting record of progress but of practical value to business men.

In obtaining comparable financial statistics, uniform accounting systems are essential. The statistics for American railroad earnings and expense have become far more useful since the Interstate Commerce Commission prescribed standardized accounting methods. Reliable comparisons can now be made between the figures for different roads.[1] Several trade associations have prepared uniform accounting systems but they have done little, as yet, toward collecting statistics and working out trade standards for comparison upon these uniform bases.

When the Harvard Bureau of Business Research undertook to secure detailed figures for operating expenses in retail shoe stores, it found that it was necessary to have a uniform system of accounting. Not only were there numerous retailers who were keeping practically no accounts, but the definitions of the several items of profit and expense were as varied as the number of stores. There were hardly two retailers, for example, who included the same items in selling expense. The Harvard System of Accounts for Shoe Retailers was therefore drawn up and when the study of the retail grocery trade was commenced a similar system for retail grocers was prepared. These accounting systems give an exact meaning to each account and make it possible to obtain comparable statistics to be used in establishing trade standards.

[1] For a discussion of railroad accounting methods, see A.M. Sakolski, *American Railroad Economics*, pp. 169–264.

In a statistical investigation the actual collection of data, for which the blank forms have been prepared and the terms defined, is carried out either by personal agents or by mail. If the purpose is to make a complete enumeration of the group under investigation, the data must ordinarily be collected by personal agents. If, on the other hand, only a sample is to be taken, it may be possible to collect the information by mail. In sampling, or testing, the object is to secure returns from a sufficiently large proportion of the group to warrant drawing conclusions for the entire group. The results do not purport to be complete but only representative, and the failure to secure replies from all to whom the inquiry is addressed does not necessarily vitiate the results.

The United States Census is a complete enumeration of the population of the country and complete statistics are obtained for most of the other subjects included. This enumeration is made by means of agents and the results would be fully accurate if the agents secured absolutely complete returns. There is, however, some degree of error in all the Census statistics. In taking the Census the enumerator is the weakest point. The Census Bureau must employ a large number of persons who have had no previous statistical training and, despite careful preparation of schedules and instructions, it is impossible to prevent occasional errors and omissions. The percentage of error, however, in most instances is negligible.

The sampling method is used by private investigators when it is impossible or impracticable to secure full statistics for the entire group with which the inquiry is concerned. If the conclusions drawn from the sample are to be reliable it is essential that the sample be fully typical. Hence in planning the investigation, care must be taken to secure returns thoroughly representative of the whole group.

An example of the sampling method is furnished by the circulation test made by the *Literary Digest* in 1912. This magazine at that time had a circulation of 265,000. The publishers wished to ascertain the interest of the subscribers in automobiles in order to show the probable value of the magazine as a medium for auto-

mobile advertising. Since it was impracticable to send an inquiry to every subscriber, letters were sent to 11,439 subscribers in sixteen cities and towns in various parts of the United States. Each letter asked the following questions: "Do you own an automobile?" "What is its make?" "What is your vocation?" Replies were obtained from seventy per cent of the persons to whom these letters were sent and upon the basis of these replies ratios were worked out for the entire subscription list. Of those who replied, 30.5 per cent were owners of automobiles. Hence it was concluded that 30.5 per cent of the total number of subscribers were automobile owners. This conclusion may be accepted as accurate if the same proportions held for subscribers who did not reply, if these sixteen cities and towns typically represented the geographical and urban distribution of the subscribers who were not circularized.

A time study in a factory is another example of a statistical test. By means of a stop watch a series of observations are made of the time required by an operative to perform a certain task. From these observations standards are worked out for future guidance. In making such a test it is essential that the conditions be normal and that a sufficient number of observations be taken.

The number of observations, or the number of replies to an inquiry, which will provide a representative sample, cannot be prescribed arbitrarily. It depends upon the range of variation which is shown — the greater the variation the larger the number required. This sampling may be likened to the testing of materials or product in a manufacturing plant, where the frequency of the tests is regulated according to the degree of variation shown. The probability of error diminishes as the number of items used for the sample increases; the greater the number of items, the more closely the results approximate those that would be shown by complete statistics for the whole group from which the sample is taken.[1]

In some investigations it is necessary to accept intelligent estimates in the place of exact figures. This is well exemplified by the

[1] A mathematical discussion of the application of the law of error to samples is given by A. L. Bowley, *Elements of Statistics*, 3d ed., pp. 308–315.

crop reports issued by the United States Department of Agriculture, the preparation of which is explained in a later article.[1] If the estimates are made independently, without bias, by a sufficiently large number of persons, they will be serviceable, since the errors in individual estimates will tend to compensate each other. If, on the other hand, there is a common bias among a large proportion of the estimators, the errors will be cumulative. It is highly important in considering the probable degree of error in any statistics to determine whether the errors tend to be compensating or to be cumulative; if they tend to be cumulative, the statistics have less value than if they tend to be compensating.

Attention should be called to another sort of estimate which has no statistical standing — an assumption or guess which, though used as the basis for more or less elaborate calculations, is largely hypothetical and not warranted by the experience of the person making it. This pseudo-statistical method is unfortunately met only too commonly. The possibility of error is great. For example, one writer, in estimating the energy used in the various countries of the world, has said: "Whenever it is impossible to ascertain the number or force of locomotives in any country, a safe estimate will be 80 horse-power for every lineal mile of railway, or else one horse-power steam to every mile run in the year by the locomotives." Again the same writer says: "It now seems to be admitted that cows give 350 gallons of milk yearly, and that 6,000 gallons make a ton of butter or 2,200 a ton of cheese." From such loose guesses pretentious totals are compiled and elaborate comparisons are made. These counterfeit statistics then circulate widely at their face value. Similarly unreliable estimates are encountered almost daily and tend to bring all statistical work into disrepute. The use of figures that have no established basis in fact often has a pernicious influence, and if estimates must be utilized, they should be labeled so conspicuously as to prevent their misuse.

When statistics are compiled from secondary sources, the methods used by the original collector should be examined and his definitions studied. Many statistics are worth far less than

[1] See pp. 138–161.

their face value because of faulty methods of collection. For secondary statistics an exact reference should always be given to indicate their source.

The tabulation of the information, after it has been collected, should be carried out in such a way as to answer definitely and clearly the purposes for which the investigation was undertaken. The exact arrangement of the tables will depend in each case upon what totals it is desired to show and upon what comparisons it is desired to make. Each column should be given an exact title that does not permit of misinterpretation and the columns should be arranged so as to bring into juxtaposition those that are to be compared.[1]

In classifying data for tabulation the chief care must be to arrange the material in such a way that its full significance will be apparent and that no confusion can arise. The limits to each of the classes in which the data are arranged should be so distinct that there will be no doubt as to where each figure belongs. In making up wage tables, for example, confusion may arise if the classes are specified as $9 to $10, $10 to $11, and $11 to $12. A proper arrangement is: $9.01 to $10, $10.01 to $11, and $11.01 to $12, or a similarly definite demarcation that avoids overlapping.

If comparisons are to be made between several groups, the groups, as a general rule, should cover equal ranges. False impressions may be gained if one class, for example, includes $9.01 to $10, another $14.01 to $16, and a third $18.01 to $21: in the first class the range is one dollar, in the second two dollars, and in the third three dollars. If the distribution of the entire series were even, the third group would include three times as many items as the first group, but this fact is likely to be overlooked, at least by the casual reader. In each case the range chosen for the classes must be determined according to the nature of the statistics and the purposes for which they are collected, but with definite classes that are equal in range.

[1] For a more detailed discussion of "tabulation," see A. L. Bowley, *Elements of Statistics*, 3d ed., pp. 73–103; also G. P. Watkins, "Theory of Statistical Tabulation," *Quarterly Publications of the American Statistical Association*, December, 1915, pp. 742–757.

Statistics are used primarily to make comparisons. These comparisons may be between classes in a group, between individual units and a whole group, between figures for the same group at different periods of time, or between two or more groups. In order that comparisons can be made, it is desirable to have for each group some summary figure or figures which shall be fairly representative of the entire group. The summary figure most commonly used is the average; in fact averages play so important a part in all statistical work that Statistics is sometimes called "the science of averages."

The term "average" is used loosely in common parlance to mean "typical," but for statistical purposes the average must be defined exactly. The simple arithmetic average is obtained by dividing the total sum by the number of items or units in the group. Thus in a retail store, in which the annual sales amount to $64,284 and which employs six salespersons, the *average* annual sales per salesperson are $10,714. This method of computing averages is common and it is generally understood.

The simple arithmetic average, however, is frequently unsatisfactory as a summary figure. If the group is not homogeneous, if the extremes are far apart and the distribution between the extremes uneven, the arithmetic average may not be identical with or even representative of any of the constituent parts of the group; the average may fall at a point that does not correspond exactly with any items in the group. A few items at either extreme of a non-homogeneous group that covers a wide range may exercise a distorting influence upon the arithmetic average. Under some circumstances the arithmetic average may fail to show changes within a large group. The average wage for the employees of a factory may remain stationary while conditions are changed. A small number of highly paid employees may receive an increase in wages while the wages of a larger number of less highly paid men are reduced, the changes just balancing themselves in the average. The average wage may be lowered in another instance merely because of the employment of a larger number of low-paid workmen, without any change in the rates of remuneration for any class of labor. Consequently, the average

wage is a worthless figure whenever the group for which it is computed includes different classes of labor with varying rates of remuneration; it throws light neither upon labor cost nor upon the welfare of the laborers. Numerous other averages must be similarly qualified.[1] It is in such cases as the preceding that a classification of the data is especially essential if comparisons are to be made.

Misleading results are frequently obtained by improperly computing an average of averages or of percentages. The following examples will make this plain. The operating income of the railroads in the United States during the fiscal year ending June 30, 1915, was as follows: Eastern District, \$299,024,764; Southern District, \$95,355,184; Western District \$327,325,769; and the total for the United States, \$721,705,717. The mileage represented in the Eastern District was 58,874; in the Southern District 42,320; in the Western District 127,360; and the total for the United States 228,554. Thus the average operating income per mile of line was \$5,079 in the Eastern District, \$2,253 in the Southern District, and \$2,570 in the Western District. The average per mile for the United States as a whole, however, was not $\frac{5079+2253+2570}{3}=3301$, but $\frac{721,705,717}{228,554}=3158$; for this purpose the total operating income of all the roads in the United States is divided by the total mileage. The average of the groups wrongly gives equal weight to all.

A second example throws further light on this matter. If it is desired to determine the average loss per fire during the years 1888–1914 from the statistics in the following table, the sum of the annual fire losses—\$4,147,119, is divided by the total number of fires during the period — 3,133. The average loss per fire is thus found to have been \$1,324. The average of the yearly figures for the average loss per fire — that is, the sum of the figures in column 3 divided by 27, the number of years — which is

[1] Another type of average is the geometric mean. It has been little used by statisticians and does not appear to have any practical application for business purposes. It is explained by A. L. Bowley, *Elements of Statistics*, 3d ed., pp. 128–129.

$1,574, is not the correct figure to use; for then the years 1888 and 1889 would be given equal weight, though one suffered almost ten times as much as the other.

ANNUAL FIRE LOSS, SPRINGFIELD, MASS.

	Fire Loss	Number of Fires	Average Loss per Fire		Fire Loss	Number of Fires	Average Loss per Fire
1888	$181,265	40	$4,531	1903	$34,454	108	$319
1889	22,430	45	498	1904	66,422	140	474
1890	35,019	60	584	1905	200,779	106	1,894
1891	227,612	62	3,671	1906	126,590	101	1,253
1892	53,428	30	1,781	1907	505,942	141	3,588
1893	376,449	73	5,157	1908	99,505	160	620
1894	60,403	84	719	1909	71,707	189	379
1895	45,168	67	674	1910	247,341	178	1,390
1896	54,380	56	971	1911	282,681	221	1,279
1897	65,049	74	879	1912	204,289	261	783
1898	237,775	65	3,658	1913	271,316	271	1,001
1899	97,610	91	1,073	1914	318,668	305	1,045
1900	46,669	73	639				
1901	120,911	48	2,519		$4,147,119	3,133	
1902	93,257	84	1,110				

Average loss per fire, 27 years, $1,324.

The same principle is frequently applicable in determining averages from the internal statistics of a single company. Thus the average net revenue per kilowatt-hour of the Buffalo General Electric Company in 1913 was 4.05 cents—determined from the statistics in the table on the next page by dividing the total Net Revenue ($1,413,203) by the total number of kilowatt-hours sold (34,855,537). The average revenue per kilowatt-hour was not 4.79 cents, the result obtained by averaging the figures for the average net revenue per kilowatt-hour for each of the nine classes of service of the company. The classes are so unequal in volume that an average of the averages is not representative.

In this instance, as in those preceding, by determining the average from the totals the figures weight themselves and give a true average.

Occasionally a grossly misleading average is figured by taking the mean between the extremes of a series; the sum of the highest and lowest figures is divided by two. The result is only an average

of the extremes, however, and not an average of the whole series or group. If the intermediate figures are known, the mean between the extremes should not be used as an average.

A weighted average is one that gives to each item an influence proportionate to its importance. If one or more items in a series represents a large portion of the entire group, in determining the

Buffalo General Electric Company, Operating Revenues, 1913

	Number of Units Sold (k.w.h.)	Net Revenue	Average Net Average Per k.w.h. Cents
Municipal street lighting, arc	7,442,382	$230,949	3.10
Municipal street lighting, incandescent	167,261	5,991	3.58
Lighting municipal building, electric	374,071	20,906	5.59
Municipal heat and power, electric	51,489	2,768	5.38
Commercial flat-rate lighting	247,597	11,011	4.45
Commercial metered lighting	19,275,928	901,966	4.68
Commercial metered power	7,173,800	231,672	3.23
Other electrical corporations	64,168	2,567	4.00
Breakdown service	58,861	5,372	9.13
	34,855,557	$1,413,203	4.05

average such item or items should be given a weight corresponding to the estimated relative importance of each. Each item is multiplied by the number chosen to represent its weight and the average is obtained by dividing the sum of the products by the sum of the weights. One of the most common uses of weighting is in the preparation of index numbers of prices, which is explained on pages 88–94. When statistics are collected by the sampling method, if the various classes in the group are not proportionately represented in the returns, it is sometimes necessary to use a weighted average for summarizing the results. Ordinarily, however, the samples should be selected so as to make weighting unnecessary, and there are few instances where a system of estimated weights need be applied to statistics used for business purposes.

Although the arithmetic average is the summary figure which is most commonly used, it is not always satisfactory and for some purposes the median or the mode is to be preferred. The median may be defined as the middle item of the group when the constitu-

ent items have been arranged in order of their size. For example, if 73 items are included in the series, the median is the 37th item; fifty per cent of the items in the series are less than the 37th item and fifty per cent are greater. The median is an exact figure; it corresponds to at least one item in the series or group; and it is not influenced by the extremes. Nevertheless, the class in which it falls may be relatively small and not typical, and it may be above or below the average if the progression of items is irregular.

The median may be supplemented by quartiles or deciles. The item in the series half-way between the low extreme and the median is the lower quartile and the item half-way between the median and the high extreme is the upper quartile. If the items of the series, arranged in order of magnitude, are divided into ten groups, each of which contains the same number of items, the

Weekly Wage	Number of Employees	Weekly Wage	Number of Employees
$4.40	19	$9.85	57
5.20	5	10.00	1
6.00	12	10.60	38
6.84	16	10.72	23
7.20	14	12.15	17
7.60	36	13.50	2
8.00	5	14.37	5
8.25	55	16.92	1
8.37	16	20.90	37

largest item in each group is a decile, the first, second, third . . . tenth, the deciles thus indicating by their nearness to each other the degree of concentration in the series. The first decile has ten per cent of the items below it and the fourth decile has forty per cent of the items below it. The median, quartiles, and deciles are concerned only with the number of items in the series, not with their range. They serve to show the regularity of distribution.

The mode, a summary figure of wide applicability, is the point of greatest frequency or density in the series, the point about which there is the greatest concentration. Consequently, if clearly defined, it is the most typical figure. It corresponds exactly to the largest class in the group and it is uninfluenced by the

extremes. In order to determine the mode it is essential that the data be grouped in classes of equal range. For illustration the statistics on the preceding page, taken from the payroll of a cotton mill, must be re-classified before they can be used for determining the mode of the series.

If these figures are re-classified in even classes of $0.50 range, we have the following table: —

Weekly Wage	Number of Employees	Weekly Wage	Number of Employees
$4.01–$4.50	19	$12.51–$13.00	0
4.51– 5.00	0	13.01– 13.50	2
5.01– 5.50	5	13.51– 14.00	0
5.51– 6.00	12	14.01– 14.50	5
6.01– 6.50	0	14.51– 15.00	0
6.51– 7.00	16	15.01– 15.50	0
7.01– 7.50	14	15.51– 16.00	0
7.51– 8.00	41	16.01– 16.50	0
8.01– 8.50	71	16.51– 17.00	1
8.51– 9.00	0	17.01– 17.50	0
9.01– 9.50	0	17.51– 18.00	0
9.51–10.00	58	18.01– 18.50	0
10.01–10.50	0	18.51– 19.00	0
10.51–11.00	61	19.01– 19.50	0
11.01–11.50	0	19.51– 20.00	0
11.51–12.00	0	20.01– 20.50	0
12.01–12.50	17	20.51– 21.00	37

The largest class is that which receives a weekly wage of $8.01 to $8.50, which includes 71 employees. The largest item in that class is for the wage group of $8.25. Hence, $8.25 is the mode of the wages received by the employees in this mill. If the mode had not been clearly indicated by this classification, a re-grouping with a wider range would have been necessary.

The above figures may also be used to illustrate the average and the median wage for this group. The arithmetic average is the total sum of wages paid ($3,609.54) divided by the total number of employees (359), or $10.05. This average does not correspond exactly with the wage received by any employee and it is clearly rendered unrepresentative by the influence which the class of employees receiving $20.90 per week has upon the result. Since there are 359 employees in the group, the median wage is

that which is received by the 180th employee, counting up from the bottom of the wage scale. The 180th employee is in the $9.85 class. In other words one-half of the employees receive $9.85 or more per week. The lower quartile is the 90th item, which occurs in the $7.60 class, and the upper quartile is the 270th item, which occurs in the $10.60 class.

In the example just cited the classified table, which shows the relative distribution of the employees according to their earnings, is more instructive than any single summary figure. The classes of employees are obviously of such unequal skill and capability that the series is not one of regular progression and a single summary figure cannot satisfactorily represent the entire group; under such circumstances even the mode is of limited significance for practical purposes.

A better illustration of the use of the mode is in the following case, in which statistics from the *Report of the Tariff Board on Schedule K* are utilized. These statistics state the percentages of actual producing time to net operating time for the looms operated by 505 weavers (women) engaged in weaving plain serge. " Net operating time " is the total time that the weavers were in the mills less the amount of time lost in filling looms and in making repairs to looms; these losses of time were due to conditions beyond the control of the weavers. " Actual producing time " is the time that the looms were actually kept in motion. The difference between " net operating time " and " actual producing time " therefore represents time lost in stoppages for which the weavers were responsible. The figures are presented as they have been classified from the original data published in the Tariff Board's report.

Percentage of Actual Producing Time to Net Operating Time	Number of Looms	Percentage of Actual Producing Time to Net Operating Time	Number of Looms
30 %–34.9 %	2	65 %–69.9 %	72
35 –39.9	8	70 –74.9	88
40 –44.9	6	75 –79.9	71
45 –49.9	12	80 –84.9	38
50 –54.9	36	85 –89.9	31
55 –59.9	46	90 –94.9	15
60 –64.9	73	95 –99.9	7

The mode is in the 70–74.9% class. To locate the mode exactly within that class the figures for the class are arranged according to narrow classes, as follows: —

70%–70.9%	13	73%–73.9%	23
71 –71.9	18	74 –74.9	16
72 –72.9	18		

The mode may therefore be taken as 73 per cent; in this case it is impractical to try to fix the mode in fractions of one per cent.

Although the above figures were collected from several mills, they are typical, and many individual mills could advantageously keep such records continuously for establishing standards of performance by means of which to check up the current work of weavers. Judging from these figures a manufacturer operating under these conditions would be warranted in establishing 73 per cent of net operating time as a minimum standard which should be reached by all weavers engaged in weaving plain serge. Although aiming at 100 per cent, or perfection, it is obvious that it could not be reached, whereas according to these figures 73 per cent is a fairly attainable minimum standard for all. Even if the weavers are paid piece rates, the interest charges on partially operated machinery and other losses through low productivity amount to large sums, a considerable portion of which might be saved if all of the weavers could be induced to keep their looms in operation at least 73 per cent of the net operating time. Since the mode is not influenced by the extremes, it is apparently better than the average as a means of establishing a standard in such a case as this.[1]

The mode can likewise be used in establishing standards from the figures obtained in time studies of factory operations. The time taken in setting the cutter on a lathe in a machine shop, as shown by a series of 52 observations, was as follows:

[1] As a matter of policy, in any particular case it might be desirable to set the standard of performance above the mode, but the exact point would be determined with reference to the mode and the concentration around it. These statements do not imply, of course, that this is the only nor necessarily always the best method of task-setting.

Time (Hundredths of a Minute)	Number of Observations Recorded	Time (Hundredths of a Minute)	Number of Observations Recorded
9	2	14	3
10	9	15	5
11	13	16	0
12	11	17	2
13	5	18	2

This table summarizes the figures recorded upon the observation sheet. The mode of the observations is 11-hundredths of a minute; in other words the workmen set the cutter most frequently in 11-hundredths of a minute. The significance of the mode is enhanced by the fact that the class next above it and the class next below it are each larger than any other classes excepting the modal class. There is a sufficiently high degree of concentration of these figures to warrant the choice of 11-hundredths of a minute as the standard time for this operation.

The mode has been used by the Harvard Bureau of Business Research in summarizing the statistics which it has collected from retail stores. In the table below, which summarizes statistics of one hundred and thirty retail shoe stores,[1] the " common figures " are modes. For each item there was a marked concentration of the figures around the mode. The " figures shown by a more efficient group of stores " are what may be called minor modes; they are figures around which there was also concentration but less than around the major modes.

The same method was followed by the Bureau in summarizing the figures for retail grocery stores.[2] These modal figures furnish the retailers with reliable standards by means of which they can check up their own results. The modes are obviously better than averages for this purpose since the modes are not influenced by the figures for any exceptional stores at either extreme.

The significance of the mode of any series of figures depends upon the degree of concentration. If the figures in the series are

[1] Bulletin Number 1, Bureau of Business Research, Harvard University. These figures were not materially affected by returns from 650 stores; the modes remained the same.

[2] *Expenses in Operating Retail Grocery Stores*, Bulletin Number 5, Bureau of Business Research, Harvard University.

fairly evenly distributed, without pronounced concentration, the mode is difficult of determination and of limited usefulness. In such a case the average is ordinarily of greater significance. If there is a marked concentration in the middle classes of the group, the average, median, and mode tend to coincide. The more unsymmetrical the distribution, the greater are the divergencies of the average, median and mode from each other. If the number

SUMMARY TABLE OF PERCENTAGES AND OTHER FIGURES FOR RETAIL SHOE STORES

Item [For Percentages, Net Sales = 100%]	Low	High	Common Figures	Percentage about which a Concentration is Sufficient to Indicate a Realizable Standard
	%	%	%	%
Gross profit	20	42	Low grade 23–25 High grade 30–33	
Total operating expense	18	35	Low grade 23 High grade 27	Low grade 20 High grade 25
Buying expense	0.8	1.8	1.1	1.0
Salesforce	5.0	10.3	8.0	7.0
Advertising	0.0	8.8	2.0	1.5
Deliveries	0.0	1.4	0.6	0.4
Rent	1.8	14.6	5.0	3.0
Interest	1.0	7.9	2.5	2.0
Number of stock-turns a year	1.0	3.6	1.8	2.5
Annual sales of average salesperson	$5,000	$16,500	$10,000	

of items in the series is small, it is not worth while to attempt to use the mode since its position may be changed by the addition of a few more items; this is also true of the median; in such cases the average is more significant than either the median or the mode.

In deciding whether the average or the mode is to be used in any particular case, reference must be had to the nature of the statistics and to the object sought. As just stated, if the distribution is fairly even, so that the mode is difficult of determination, the average will usually be preferred. But when the mode is clearly defined, it is especially useful in determining standards. After a standard has been determined by the mode, the results of

later operations or observations can oftentimes best be compared with the modal standard by means of averages. The average gives full weight to the extremes, and this is desirable if a comparison of current results with established standards is the object. In such a case as that of the serge weavers, for which statistics were given on page 25, after a standard of performance has been set by the mode the average of the results for a current week for all weavers on that kind of work in a mill could be compared with the standard to show how far the total results fell short of the standard.[1] For such a purpose the extremely high and the extremely low figures should be included in the average. The modal figure for the current week, unaffected by the extremes, would not show the degree of attainment of the entire group.

From what has been stated in the foregoing pages, it is evident that the larger the number of observations or the more comprehensive the records, the greater is the significance of the average or other summary figures which are worked out. This is due to what is sometimes called the "inertia of large numbers" or the "law of averages." The larger the mass, the less is the influence of exceptional instances. Statistics serve not only as a check upon current operations but also as guides for the formulation of future policies since we can assume that, if we have a sufficiently broad basis for our conclusions, the same results will probably be shown under similar conditions in the future as in the past. It is upon this theory of probabilities that statistical science is founded.

II. Statistical Units[2]

By G. P. Watkins

The name statistics denotes both a method, or methods, of utilizing a certain class of facts for scientific or practical purposes, and also the facts or materials of knowledge that may be so utilized. It is with the materials accessible to exploitation by statistical

[1] The results shown by each weaver would, of course, be compared with the standard by the overseer of the weaving department. The comparison of the average with the standard would be of most interest to the mill superintendent, who is not so much interested in the records of individual weavers as in totals.

[2] *Quarterly Journal of Economics*, xxvi, pp. 673–702. Reprinted by permission of the *Quarterly Journal of Economics*.

methods that this paper deals. These materials are superficially distinguished as being numerical. Is it to be inferred that all numbers are statistics? Or, to put the same question in a different way, are they all statistical material of equal grade?

Statistics combines units into aggregates and recombines aggregates into totals. For comparison, the aggregates are then analyzed and condensed into significant averages and ratios. The quality of the product of these processes depends upon the adequacy of methods employed and upon the quality of the raw material. The quality of the material is conditioned by the character of the unit and by the completeness and correctness of the combination of the units into aggregates. In other words, the quality of statistical material varies with the adequacy of the count and with the character of the unit counted.

As regards the comparative importance of accuracy in enumeration and compilation, on the one hand, and of the character of the unit dealt with, on the other, it is sufficient here to affirm the equal importance of the latter and let the following pages be the evidence. So far as accuracy means exactness as distinguished from mere representativeness (if it might be assumed that we could have the second without a good deal of attention to the first) the superior importance of the character of the statistical unit, though so little noticed, should be evident to those having acquaintance with the actual processes of statistical cumulation.

The uses to which numerical data may be put depend upon the kind of unit more fundamentally than upon anything else. The quality of a product is always conditioned or limited by its ingredients. It is, of course, fundamental to know what the unit employed means, that is, its denotation and connotation must be clear. But when all requirements of definition and conception are met, the unit may still be good or bad, and consequently, the numbers obtained more or less amenable to statistical use. It is an incident of this distinction that some divisions of statistics, in their existing state, must be given lower scientific rank than others.

The scheme of classifying statistical units here proposed is as follows: —

A. Individual things the quantity of which is determined by counting.

1. Natural kinds and events relating to natural kinds.
2. Produced kinds and produced qualities of things.

B. Mensurational units which are applied to determine quantity without regard to individuality.

3. Physical measures (of length, capacity, etc.).
4. Measures of pecuniary value.

These classes of units are arranged in the descending order of their statistical quality. In this order we shall discuss them.

The Natural Kind

The conception of a distinction of kinds as developed by J. S. Mill in his *Logic* (book I, chap. vii, § 4) is as follows: —

> There are some classes, the things contained in which differ from other things only in certain particulars which may be numbered, while others differ in more than can be numbered, more even than we need ever expect to know. Some classes have little or nothing in common to characterize them by, except precisely what is connoted by the name: white things, for example, are not distinguished by any common properties except whiteness; or if they are, it is only by such as are in some way dependent on, or connected with, whiteness. But a hundred generations have not exhausted the common properties of animals or of plants, of sulphur or of phosphorus. . . . If any one even chooses to say that the one classification is made by nature, the other by us for our convenience, he will be right; provided he means no more than this: Where a certain apparent difference between things (though perhaps in itself of little moment) answers to we know not what number of other differences, pervading not only their known properties, but properties yet undiscovered, it is not optional but imperative to recognize this difference as the foundation of a specific distinction.

Demography, or population statistics, has for its principal unit the human individual, and human individuals constitute a natural kind. Other examples of natural kinds in statistics are the various raw products of the animal and vegetable world, the numbers of which are usually obtained by counting discrete units.

It is evident that where the statistical unit is a natural kind it is superior in respect of both definiteness and fulness of meaning to any that requires an artificial distinction, however well thought out. It follows that, other things equal, the highest grade of statistics is composed of numbers relating to natural

kinds. Though the best examples are the orders, species, etc., of animals and plants, any natural and therefore more or less genealogical method of distinguishing objects would give classes of the same character. "Sticks and stones," as well as animals and plants, might be divided into natural kinds, though probably differences of behavior are so helpful in classification that unmanufactured inanimate objects would not so readily lend themselves to the differentiation of kinds as do living things. But a genealogy of atoms and molecules and even of their associations and mixtures is conceivable; and it could not fail to show natural differences of kind.

Natural classification is the opposite of mathematical. A mathematical classification might be arrived at by a development of the permutations and combinations of specified qualities which would make of each combination a species. In a natural classification, definition does not depend on a single point but oftener upon a combination of characters, some of which may be absent. To classify plants merely according to the number of pistils and stamens is in this sense "mathematical." Defining by reference to a single point and hinging classification on such definition is a thing to guard against. Distinctiveness, in the sense of recognizability, is not to be attained that way, any more than is a workable classification. Statisticians sometimes fail to distinguish between clearness of discrimination — which is best tested by promptness of recognition — and sharpness of definition.

A very great advantage of the natural kind as a unit consists in its ordinarily being recognizable without the aid of definition. It is not necessary for the enumerator to exercise great discrimination in determining whether an animal is a horse or a cow. This is not the same as saying that there will be no doubtful cases in the discrimination of natural kinds, cases where the use of carefully devised definition must be resorted to. But the discrimination of the natural kind does not ordinarily depend upon them, while in the case of an arbitrary or "mathematical" classification it is likely to.

Statistics relating to sex and race deal with differences of kind. This fact adds greatly to the significance of the results of a count,

even where, as in the case of races, mixtures are of frequent occurrence and definition, therefore, not easy. The different species of domestic animals are also natural kinds. Ox-hides are, consequently, a natural kind, but shoes are not. A census of farm animals gives reliable results strictly in proportion to the care with which the enumeration is made, while a census of occupations or of manufacturing establishments may give somewhat uncertain and disputed results despite the greatest care and conscientiousness.

Variation in the size of units may be urged as an objection to the adequacy of counting as a means of determining quantity. In the case of a natural kind such variation is easily disposed of. It is ordinarily quite regularly distributed about a mean. If it be desirable to gage the character and range of such variation, the problem is one with which the statistical method is especially competent to deal. This is the nature of most statistical biology.

Variations in size may be studied as a means to the further and fuller characterization of the kind. Counting by size classes and sub-classes may be a sufficient substitute for detailed measures. Coefficients of variation for such variations as are of fairly constant character may thus be determined. When the variation, both quantitative and qualitative, about the mean is found to be very nearly constant, once these coefficients are determined, totals may convey all the information that it is necessary to obtain by actual count, the rest being easily estimated. It would seldom be necessary to specify the quantity of the sizes of grains in a bushel of wheat, or of fish in a catch, or of range cattle in a herd.

Natural kinds may undergo secular or evolutionary change. Cattle have increased greatly in weight in the past few centuries. This is an important statistical element which might seriously affect a comparison. But the presence of such a change is easily ascertained. To make proper allowance for its influence is not difficult. Secular change in the character of the statistical unit is one of the least troublesome phases of definiteness.

Counting is the usual method of obtaining statistics of natural kinds. Measuring, though sometimes a practical convenience,

is never a logical necessity. Counting will tell more than mere measuring.

Differences in the degree of some quality of a natural kind partake of the statistical character of the unit to which they pertain. Age is an example. That it is measured in terms of astronomical periods is logically an accident. Ages represent differences in the degree or stage of development of a group of natural qualities, called, according to the varying stages, youth, maturity, senility, etc.

Births and deaths are events relating to natural kinds and they have a corresponding statistical standing. Thus vital statistics in general have a unit of the first order. But the status of a marriage is somewhat different. At least as legally defined, it is as much artificial as natural.

To summarize the conclusions drawn from the foregoing: Statistics of natural kinds are superior to such as are based upon some other sort of unit, both negatively and positively. Misunderstandings of the informant, of the enumerator, and of the compiler should be at a minimum in the case of such a unit. Instruction in niceties of definition is seldom necessary. And this ready recognizability is no accident; it results from the nature of things. Positively, also, such statistics have fuller meaning and may at any time develop an unexpected significance. A division into natural kinds is more concrete than one requiring abstract definition. Relations with other objects are clearest where the terms are ordinarily concrete or discrete kinds. Much may be made of statistics of natural kinds even where there has been no careful attention to classification.

Products as Statistical Units

In calling the second order of statistical units "produced" objects we bring in the idea of economic production. Economic goods are the result of modifications of natural materials for human uses and purposes. The materials may still have the properties of natural kinds. But the statistics of such things will relate primarily to the distinctly produced qualities. Classes of these are not fixed and objectively definite. The purpose and function

of the same article may vary, and physically different goods may, on the other hand, be made to serve the same purpose. A door is not a door when it has been converted into a table top. But it is not so easy to say when a street car ceases by reason of decrepitude to be a car. Corn is not fodder when it becomes fuel. If a chair is something to sit in, what is a stepladder chair? Personal idiosyncrasy as well as human reason may be a factor in such classifications.

The foregoing illustrations suggest the fundamental difference between units of the first order and those of the second order. Among the latter, definition and classification hinge mainly upon function. Natural kinds are defined otherwise. It is significant that the biologist finds functional characters of little or no use for the purpose of classification.

Manufactured commodities and instruments and the produced qualities of natural and other objects comprehend virtually the whole of the second order of units. The drawing of the line between such objects and natural kinds is not always so easy as might appear, but that need not detain us.

With this sort of unit difficulties of definition do not, as with natural kinds, amount to less in practice than in theory. An important group of such difficulties consists of those resulting from a compound purpose — the case of a tool that will do several things equally well, or a wage-earner who has two occupations. Difficulties of definition are familiar in relation to numbers employed by a particular concern or in a particular occupation. Complications due to time lost, part-time employees, and subsidiary occupations, are ghosts that refuse to be laid. Apparatus in use or available will be returned variously until the use and the degree of need of reserves for repairs and emergencies becomes more nearly determinate. It is not an accident that these examples, though there was no such intention, come from industrial statistics. Here much more depends upon good classification, or rather upon careful attention to classification and definition, than is the case in dealing with natural kinds.

Freight and passenger cars of the railways are characteristic made kinds, with a good deal of recognizability, but sometimes

also occasioning much perplexity in border cases. How shall cabooses, how combination express and mail cars be classified? One street railway has been known to return the little-used private car of its president as a freight car. Difficulties are sure to arise where classification depends ultimately upon purpose, even though incidental details of physical construction ordinarily help, perhaps in the end only to increase the doubts and difficulties when they do arise. It is the purpose of the maker and of the user, not the observer's notion of what is suitable, that is referred to, hence the criterion is comparatively objective. To define by the purpose of the maker is one way to make the required definitions clear and easily applied. This should be done, even at the cost of some degree of arbitrariness.

Produced qualities as well as produced objects have the characteristics of this second sort of unit. Social status in general, for example conjugal condition, probably belongs here. Occupations, and with them statistics of wages, clearly belong here. Wages really describe a produced quality of the person in the occupation, or the degree of such a quality. Hence wage statistics are not to be classed under the value unit, where they appear to belong. They are attached to a definite object, a human being, and afford knowledge of a certain produced quality.

It is probable that, as time goes on, this kind of statistical unit will tend to improve in character, quite apart from any statistical interest in such improvement. The modern tendency towards standardization of instruments and products is of increasing importance as markets become larger and productive processes more complex. Staple and standardized commodities are better suited to such conditions. Commercial variations in a given commodity that are not dishonest will tend to be fewer because the consumer will feel himself less able to cope with complexities. Statisticians and administrative officers will doubtless discover and apply means of preventing dishonest variations in commercial units. It does not so much matter what the unit is, provided it be fairly constant. That matters more and more, in practical ways as well as scientifically.

There are units which are intermediate in character between the first and second orders. Such is apparently the family. In

itself natural — at least there is a natural family — so many of its functions and traits are artificial or economic that the United States Census, perforce, defines it artificially. Yet inferences as regards the natural family derived from such statistics are not entirely bad.

The city also, so far as it is a statistical unit, has a similar intermediate character. Inequality of size would not be an objection to its use, though any exploitation of such figures could scarcely fail to take account of this. If a fully natural kind, its definition would not, of course, hinge upon corporate geographical boundaries. But cities are rather too few in number for the " trees " to lose their individuality in the " forest," hence there is less need of, and less opportunity for, aggregate or statistical treatment of the city as such.

The business corporation is legally and in some other respects analogous to the city. Here there is certainly a " forest." There is no reason why we should not have true statistics of corporations. The unit is not perfect. It is in the main a produced unit, and the size and internal organization of corporations vary greatly. It is not entirely a produced unit, however, since it is a group of persons and has most of the qualities of the individuals who compose and direct it.

Whether nationality is a produced quality or a phase of a natural difference in kind may be doubted. It is a border case. A Frenchman may be of Teutonic stock, but he is French if his language, culture, and traditional sympathies are French. The characteristic element in statistics of immigration is usually nationality, hence such statistics are more of the second order than of any other.

Statistics of manufactured objects are gathered mainly by means of enumeration and their class or descriptive name will ordinarily tell much about them. But it will not always tell enough, even where much discrimination is exercised in determining what is to be counted and even when, also, the classes of objects are subdivided in the count. Hence a specially significant unit, one that is indirectly a unit of capacity, may sometimes be employed as a basis for addition and comparison. Thus statistics

of cotton-spinning manufacture take as their unit the spindle. In some cases odd units may be reduced to a common denominator, as in the case of the standard 500 pound bale of cotton-ginning statistics.

Sometimes counting produced objects quite fails of its purpose and resort is had to measurement. Hence statistics of capacity in combination with number, examples being the tonnage of ships, the capacity of grain elevators and of engines for power production. This case is transitional to the next class of statistics, where the unit is primarily a measure of size or capacity instead of a concrete object. Counting by size-classes or grades, however, may sometimes be preferable to measurement.

Physical Measurement Units

Physical measurement units compose the third kind of statistical unit. Examples of physical measurement units are the ordinary measures of length, of cubical capacity, and of weight, and measures of energy like the horse-power and the kilowatt-hour.

The size of such a unit is the result of accident and convention. The length of the foot of some king is as good as a decimal fraction of the miscalculated circumference of the earth. The horse-power may as well have a merely arbitrary as any other relation to the power of an average horse. There is no particular reason why the yard or the pound should count for one, except convention and convenience. There should be some common and familiar standard. What it is, signifies little. Similarly it is necessary to have a rule of the road, but whether it says that one shall turn to the right or to the left does not matter. That the unit be accepted as standard is all that is necessary. There is a marked contrast between this situation and the way in which the statistical unit is determined for a natural kind. There we find nothing arbitrary or conventional.

But, though the fact that units are merely conventional does not matter, there should be no variability or ambiguity in the convention. Our abominable English weights and measures include several different kinds of pounds, tons, quarts. Quantities

reported in tons are only presumptively known unless the unit is described every time it is given. The most definite schedules are likely to be filled carelessly.

Engineers have been too ready to accept a situation as regards their peculiar technical terms which is not much better. Statistics of rated capacity of power equipment suffer considerably from lack of standardization. But the engineering societies are now attending to such matters. Mention may be made especially of the American Institute of Electrical Engineers. The work of the National Bureau of Standards insures steady improvement in metrology generally.

The very fact that the unit is a measure more or less arbitrarily arrived at, and incidentally become customary or standard, suggests its limitations. Measuring ignores individuality and disregards all but one of the qualities of the objects measured. In statistics of the third order we no longer count the members of a kind and in naming also describe them. The significant relations of a measurement unit to things in general must, of necessity, be narrow because unilateral. They take account of only one thing at a time. A particular steam engine has a determinate relation to the men who run it and to the machines for which it furnishes power, but "ten horse-power" has no such relation to other things. It tells something about an engine, but does not mean the same for a ten horse-power engine as for one of a hundred horse-power. It is more important to know the number of engines and their size (by classes) than their aggregate power. But we sometimes have to be content with horse-power alone.

Measurements always involve abstraction. A measurement gives length, or cubical contents, or specific gravity, any one of which abstracts from all but a single quality or relation. Diverse measurements may give several such facts about a series of objects, but the results are still abstract. If we are to learn about the real concrete things it must be by way of supplementary or collateral information, not always statistical in character. Capacity may be measured, disregarding shape; weight, disregarding material; the figures thus limit themselves. The counting of discrete natural objects, on the other hand, gives numerical

knowledge which can be supplemented to any desired extent by reference to natural qualities.

When objects are both measured and counted, which is to be regarded as the primary datum? On the whole the counted object should be primary because of its superior character as a unit, though the greater importance of the measurement unit may sometimes outweigh this consideration. It is well, whenever possible, to have both sorts of quantity and also to have the two clearly related, i. e., the numbers by sizes or by size-classes.

Sometimes what appears to be measurement is in effect only a quicker way of counting. It may be more convenient to determine the number of new coins in a package by weight than by tale. But the result is not less a number of coins. Commodities are often weighed merely because this is the best way to arrive at their amount. Bushels are used to measure grain. The object so measured is a natural kind composed of individual things. Relations to other things, for example to nutritive value and tastiness, are not at all left out of account. In these cases measures are not resorted to because of diversity of type and of size among the objects, as in the case of produced articles such as generating engines. Natural kinds seldom require this, even where we are directly interested in their size, for they vary regularly about a representative mean. But the size of some marketable products is so largely produced that it has almost ceased to be a natural property of the kind; hence, there is a tendency to determine quantities of such things by weight, even when the article is sold in its natural state. If it is becoming true, however, that eggs should be sold by weight instead of by count, this is chiefly because of the work of the breeder in developing marked varieties of the domestic fowl. The size of the egg is coming to depend on the breeder's art.

Measurement aggregates may consist of one continuous quantity or a homogeneous mass, or they may relate to a miscellaneous lot of individual things which are varying multiples of the measurement unit. The latter case seems to be the more frequent in statistics, perhaps because the more evolved and individualized things, whether made such by nature or by man, that is whether

biological species or manufactured articles, are of more interest to us. But it is probably with the former class of materials that measurement begins, later extending to objects that might also be counted. The homogeneous material may, of course, be a natural kind, but not of the most interesting order. So far as it is such, a measured amount of it, of water or sand, for example, may have some of the advantages of the first order of unit— some only, however, because such unintegrated matter too readily mixes and mingles with other things.

Accuracy of measurement deserves notice in this connection by way of distinction from accuracy of counting, and also for comparison with it. The definition of the measurement unit offers practically no difficulties. The number of units to be recorded usually involves some mathematical computation upon the basis of comparison with a standard measure, or it may be obtained by estimation upon a more or less objective basis. There is not so much difference between measuring and objectively estimating quantities as one might easily assume. The view of an expert with the time and facilities for applying objective tests to check his results is worth much more here than it is in the field of counted units. The method of sampling can, in this case, if intelligently used, be adequate for most statistical purposes. The way in which several measurements are employed to check each other by the physicist and mathematician, and are assumed to be inevitably more or less approximate, illustrates the necessary inexactness of human measurement and also suggests that " mathematical exactness " may often be practically unimportant as well as unattainable. If we dealt with the objectively checked estimates of impartial experts as the mathematical physicist deals with quantitative observations, we might find them very nearly as good for most of the purposes of statistics as "exact" measurements.

It sometimes happens that the reduction of odd articles to a common measurement standard is desirable. Provided the material contained is homogeneous, little is lost. But caution in the use of this short-cut is imperative. The day's work, for example, is not merely so many hours of work. A 16-hour day is by no means equal to two 8-hour days; nor is a 48-hours-a-week sched-

ule the same regardless of how or when the time is put in. Sometimes administrative regard for facility of enumeration may cause a too easy acceptance of the measurement unit in such cases, when varieties and their relative importance are quite as interesting as totals and averages.

Some statistical units in common use are compound. This is especially true of units of physical capacity and performance, that is, of such as have the characteristics of our third class. Such a unit usually takes up whatever disadvantages pertain to both its terms. The foot-pound is only apparently such; its compound name resulting from the attempt to make concrete an abstract conception. Foot-pounds per hour is truly compound; hence horse-power is compound. The car-mile and car-hour are compound. The vagueness that attaches to these units follows from the character of the basic unit, which is of the second class. It is important to know the size of the car and whether trailers are used. But the grade and curvature of the road also affect the significance of such a unit. If the idea is to measure the potential service performed by a passenger car, the seat-mile is more to the purpose. One term of this unit is of the first order. The ton-mile unit is of the third order as regards both its terms. But data for ton mileage and seat mileage do not make it possible to dispense with car mileage.

Comparability is the fundamental desideratum of statistical data. There is no difficulty about it with natural kinds. There is a good deal with produced objects. The difficulty is apparently met by the use of measurement units, but the solution is often apparent only. The additive quality is secured, but perhaps at the cost of losing trace of important relations to other things. Hence measurement as a means of obtaining a total aggregate amount is to be considered a supplement to, not a substitute for, counting, whenever the quantities dealt with are composed of discrete natural objects.

The Pecuniary Unit

The fourth order of statistical unit is the unit of commercial value. It is possible that some other than the monetary measure might be found that could serve as a basis for value statistics. In

fact, however, the only sort of unit we use is something reducible to the dollar. Whether any and all statistics of this fourth class should be called financial, or financial and commercial, as seems to be the tendency, is questionable. But financial statistics are representative of the class.

One reason why the pecuniary unit bulks so large in common statistics, including business statistics, is because it is the most universal of common denominators. There is not much of practical interest in the world that does not, at least occasionally, have a pecuniary value assigned to it. Nor is the tendency to attribute to all things a pecuniary value so reprehensible as is often alleged. The error, which is a moral as well as intellectual error, consists not in the extended application of the pecuniary measure, but in supposing that it has an intensiveness, comprehensiveness and independence of meaning which is foreign to its nature. Just because of the general applicability of the dollar as a common denominator, its definable content and meaning must be small. All measurement units suffer by reason of their abstractness. The most universal of common denominators, despite its fundamental interest for every human being living in an exchange economy, will naturally suffer most in this way.

In citing examples of the fourth order of statistics we can hardly refrain from commenting on their quality. Statistical inferiority is characteristic of numerical data based upon the pecuniary unit. A review of examples of such statistics becomes a process of learning why this is so. Hence this judgment may as well be put at the front of this section. It applies with full force, however, only when the pecuniary unit is used by itself and as standing on its own bottom.

Financial reports are the sources of most pecuniary statistics. Our statistics of railways, in the main pecuniary, are among the best examples of the class. An authoritatively prescribed uniform system of accounts will make them vastly better than they were before. Statistics of assessed valuation and of taxation are a less developed variety of the fourth order. But, if we wish to prove that we are economically better off than were our forefathers a hundred years ago, it would be sounder to argue less

from the increase in *per capita* wealth than from the application of invention to promote abundance and variety of goods. Statistics of export and import trade are almost altogether pecuniary as to their unit, largely because of a possibly too great regard for administrative convenience. Hence it is easy not to determine just what is the status and recent tendency of British trade or just what our own trade balance signifies. Aside from disturbing factors peculiar to international trade, the level of prices changes with time and place and with it the meaning of the pecuniary unit. Finally, our statistics of capital and capitalization are most completely pecuniary. Despite great practical interest in them, all such data are, as compared with demographic statistics, scientifically barren. The almost exclusively practical interest of their compilation is no sufficient explanation. On the contrary, this should provide richer and better material for analysis by the scientifically disposed.

One reason why pecuniary statistics are so generally unreliable as to their comparability, and therefore as to their significance, is because they are usually derived from books of account. Accounting theories and practices are anything but uniform as regards their treatment of particular items. Indeed, less elasticity of method and usage would often serve less well the purposes of business men. Accountants, for their lack of breadth of view, deserve part of the blame. But the public interest in the intelligibility of financial statements is gradually establishing authorities to prescribe and compel uniformity in such matters. Until uniform systems of accounts have been in effect long enough to insure their smooth and accurate working, our financial compilations will fall much short of being entitled to the standing that should be connoted by the name statistics. Accounting entries ought to have constant significance and comparability. The mere accountant has been too much inclined to make his own financial balances the *ne plus ultra* of his work.

The investor is likely to form his opinion of a stock on the basis of what it pays in dividends. But if he is alert he will consider rather the net income earned from year to year. Though much speculation has just so superficial a basis, a dealer in stocks will

go deeper. The investment expert of a broker or banker will go as far into a company's reports as there are data. He will, if possible, analyze the physical statistics. That he does not give more attention to such matters may be explained by the usual absence of the necessary information. Even the expert, however, is likely to give the investor chiefly the tabulations of gross and net income to which he is accustomed rather than educate him up to some understanding of the physical basis of profits.

If profits are really there, the basis is physical as well as economic. But the basis of net income as it stands in a company's report may be neither physical nor economic. With accounting methods not yet fixed and with the management unchecked by statistical indices of physical condition, it is quite possible, especially through maintenance accounts, to juggle with net income in ways that no superficial analysis will disclose. Depreciation can be charged only on an accrued or estimated basis and we have as yet no sufficient experience to check the basis, though we have had plenty of experience of the arbitrariness and manipulation of maintenance charges. All this relates to property operated. Intercorporate relations and resulting elusive " other income " offer another handle for manipulation. The line between capital expenditures and operating expenses is in its nature indefinite. That between expenses of the period and of other periods (or years) is equally so, especially on account of depreciation. Hence the necessity of honesty and — as a guaranty of honesty and competence — full data to enable the outsider to form an opinion. " Accrued " income may often be more properly described as contingent. Hence the " actually paid " basis of the federal corporation tax. The government can wait for the long run. But the outside investor may be " cleaned out " long before the consummation of long-term changes whose probable effect he is not permitted to see.

Merely financial reports are not adequate to the use to be made of them. It is of the essence of accounts that they cannot be so. " Net income " is as much a result of how the books are kept as of profitable business transactions. It should not by itself be the test of solvency but should be supplemented by full operating and physical statistics.

The inferiority of the fourth order of statistics, however, is due to more fundamental causes than arbitrariness of accounting practice. The dollar is intrinsically inferior as a statistical unit. The physical measurement unit as well as the pecuniary unit is the expression of a relation and not discrete; but the former can easily be so conceived while the latter cannot. The dollar unit is so completely abstract as to be not even imaginable. It is a measure of "power in exchange." But the dollar's power in exchange does not mean the same thing to any two persons. Even if subjected to the test of actual exchange and determined by market conditions the purchasing power of a dollar fluctuates, hence estimation must be resorted to and allowance made for time and place. Even then much depends on "whose ox is gored." Financial data usually have the character of interested estimates. Differences in valuation are not mere variations around a mean and are not moderate. Hence they are not easily dealt with or lightly to be disregarded. Reducing to a fine gold equivalent is merely a way of getting around diversity of currency. Changes in rates of exchange are a minor adjustment, for custom and "psychology" are factors in price. The symbol is familiar and constant. That for which it stands changes in ways not easily determinable, certainly not to be simply ignored.

The method of index numbers — itself a nice problem in statistics — largely meets such difficulties with the value unit as are due to changes in time. Logically, however, the index should change with every purpose for which statistics of the fourth order are used. The proportionate weights of the prices of particular articles which are determined by the consumption of wage-earners in a manufacturing community seem to be of greatest use. But they are not therefore generally adapted to all purposes, even though adjustment of the weights cannot be alleged to be indispensable.

The financial statistics showered upon us do not have the definiteness of meaning that statistics may be expected to and *ought* to have. Efforts should be made to close the existing great gap in scientific character between financial and demographic statistics. For taxation and financial administration and for the public

control of corporate management, adequate statistical data will become more and more necessary. This refers to the need of governmental action. Purely private interests (if there be such) are also involved. Many large corporations are coming to feel that they ought to make the knowledge of their operations accessible to the public, at least to their actual and possible stockholders. The statistician thus tends to be a necessary aid in the conduct of every large corporate enterprise.

A suggestion of the direction which improvement will take is contained in the rather obvious proposition that economic and pecuniary statistics are not necessarily the same. The backward state of economic statistics, as compared with demographic, is doubtless largely due to a too ready acceptance of figures of value as a satisfactory answer to economic questions. But economic statistics need not be so superficial. They will, when fairly complete, doubtless contain values, but will not be composed of them. Statistics of manufactures and trade ought to present quantities and kinds of products as well as values or prices. Our agricultural statisticians do this very largely, though they too sometimes seem to prefer to detach the values from all other numbers relating to their data. Even where the interest is purely commercial or financial the trend is towards more adequate figures. We are told of tons of rails produced as well as of the value of the output. It would be still better to have the kinds specified, i. e., the weight per yard and the material, perhaps also the shape, — things which, it should be observed, are seldom necessary in statistics of natural kinds. Our numerous practical "statistical" manuals designed for investors need to pay more attention to such possibilities. But the large corporation must first appreciate the importance of compiling and making public more adequate data.

Index numbers have been referred to above as affording a way out of some of the difficulties of statistics resting upon the pecuniary unit. This is a way to get beyond pecuniary value and down to concrete goods. We may thus learn what the dollar means in terms of necessary articles of consumption. The device is practically the determination of an equation between money and commodities. The principle of this solution ought to be more generally applied.

A Way to Better Statistical Material, especially to Better Economic Statistics

While it is of some scientific interest to distinguish different orders of statistical units and of statistics, what the distinction is really worth depends upon what purposes it may serve. For statistical practice the important question is: How can the inferior orders of statistics be improved?

Statistics first achieved scientific standing in the field of vital statistics and demography, that is, in a general way, among natural kinds. Whether as an extension of the viewpoint of "political arithmetic" or as an intensive development, statistics that are something more than mere numbers have come rather later in other fields. Among the divisions of our federal census the volumes on population are, as statistics, the best; those on agriculture (the units here also being chiefly natural kinds) rank next; and last or lowest in quality are the statistics of manufactures, the reason being that the unit is too largely pecuniary.[1] One might well infer that our statistics of manufactures should be made less dependent on the pecuniary unit. This is not meant to imply that our census officials are unaware of the need.

The way to improve pecuniary statistics is to relate values and prices, present and past, to the things to which they pertain, or rather to the statistics of those things. Pecuniary statistics should be, so far as possible, either accessory to or supported by statistics of higher orders. An amount paid in wages immediately provokes a question as to the number and kind of wage-earners, how long they worked, and whether on full time or part time. It is not enough to know the value of our exports of a particular class of commodities, though the difficulty of defining varieties does in part excuse the shortcoming. Railroads want to know the relation of expenditures to work done, hence ratios of cost and of traffic to various operating units, expenses and revenues per train-mile, ton-mile, etc. New uses of such units and ratios are con-

[1] The defects of the volumes on vital statistics — the statistics obtained by enumeration as distinguished from the recent compilations of mortality registration records — do not vitiate the comparison because their condition is due mainly to accident in the development of our statistical administration.

stantly appearing. Detailed power and wage statistics serve the same purpose and will soon be considered a necessary part of the classified and analyzed records of any large private corporation. It is a need of our mental nature that values be predicated of definite things. As the workings of our minds are pragmatic, this need points to a function.

Especially statistics of capitalization need to be related to the statistics of capital or of the means of production upon the basis of which securities are issued. This happens to be a degree removed from the direct interest of active business men, hence " neglect " does not sufficiently describe their attitude in the matter. Some of the uses to which physical valuation might be put may reasonably be objected to, but to the thing itself there is no valid objection. The investor should be put in position to know his property. The only way in which such knowledge can be conveyed to his understanding in the case of a large corporation is by statistical description. This is the foundation and essence of physical valuation. A corporation cannot properly have secrets. Especially in relation to its stockholders, its duty is not merely the negative one of abstaining from withholding information. Even if the corporate net income be the basis upon which the investor buys the stock, its stability as well as its amount is important and the probable stability of the income depends chiefly upon an adequate physical basis.

Economists of a certain tendency share with business men the blame for inadequate notions of how financial statistics ought to be looked upon, at least as regards the phase of them that relates to capitalization. The capital value concept is useful and important. The attempt to wash out the distinction between capital as a sum of value and capital as concrete means of production, or what amounts to this, to ignore the latter meaning, is very much the opposite of useful. The dominance of the corporate form of organization makes it important not to destroy, but to develop the idea of capital as concrete means of production. The small individual entrepreneur does not know less of what he possesses by reason of the fact that he reduces all to terms of value as a common denominator. The stockholder of a large corporation is

differently situated. He can know what he possesses and how it is being used only by means of adequate physical and operating statistics, including data of performance, duly reported to him. Mere balance-sheet and income statements are not sufficient. Here is where the capital-value theorists may have occasioned some distraction of attention from real needs. With adequate inventories of extant properties, capital assets could not be made to include dead horses, tracks removed, obsolete and unused implements, all and sundry covered by combination and by temporary monopoly or other advantage, without security for the continuance of such advantage and thus with loss to the investor. Uniform accounting systems should largely take care of this need as well as of the proper treatment of accounts in the customary narrower sense, as distinguished from records.

Accounts should, in general, be supplemented by records or statistics, though the word so used sounds pretentious. The inventory made once a year, or oftener in the case of a mercantile stock, should not be dispensed with in the case of fixed capital. Though it need not be made so often, we know that fixed capital also may disappear in ways not accounted for. Corporations have their "storekeepers" who carefully check and record whatever materials and supplies they receive and issue. Should not there be records also of the more valuable tangible assets? As statistics constitute the state's means of knowing itself, so the only available means by which a large corporation can know itself are likewise statistics, both physical or static statistics and operating statistics. So far as size is the compelling factor, there are modern business corporations quite as large as were important states when statistics first began to be.

So-called cost accounting, or cost keeping, occupies much the same position in relation to operating statistics as does physical valuation in relation to the knowledge and quantitative estimation of fixed investment. It is an attempt to show the connection between fundamental physical facts — quantity and kinds of raw materials, labor time of various sorts, space and power required — and the quantity and value of products. It is essentially statistics rather than accounting, since in it numerical comparisons are

more important than the registering and balancing of pecuniary obligations. The development of cost keeping in the business world is a phase of the increasing importance of statistics.

Any considerable acquaintance with compilations of numbers in tabular form should make it clear that not all figures are statistics, nor all figurers statisticians. Economists without special statistical interest or training have probably contributed to the general misconception of statistics as merely masses of figures. The large corporation is now coming to feel it desirable to have a statistician, though he is still likely to be regarded as a special kind of clerk, one who is "quick at figures." Sometime it will be recognized that neither an accountant's nor an engineer's training specially qualifies for statistical work. The statistician should be grounded in demography and familiar with the statistical methods used in dealing with natural kinds, no matter how "practical" his later work is to be. It is true also that he cannot have too realistic a knowledge of his special field. The differentiation between the accountant and the statistician will probably come to mean that the latter is specially competent to deal with physical things in their numerical and quantitative aspects by means of methods suggested by a study of the higher orders of statistics.

Figures are symbols. They serve only to connect our thoughts with things. Not all statistics do this with equal directness and sureness. It holds especially of figures based upon the commercial unit of value that the meaning is not self-evident. The measure of value is less intelligible than physical measures. Statistics based upon measurement units are, in general, less good than counts, whenever the kinds counted are adequately classed and of well-defined character. Realistic comprehension is scarcely possible with value measures unless they are definitely related to things. Things valued should be also defined and counted, or at least physically measured. The statistician must see the quantitative relations of the numbered things, not the mere symbols or numbers. As statistics becomes of greater recognized importance and as its methods are applied to more and more branches of knowledge — being thus of doubly increased significance — the greater will be the need to attend to such considerations as

are mentioned in this paper. We shall supplement statistics of produced kinds with measurements, instead of beginning and so largely ending with the most abstract of measurement units, thus getting the cart before the horse. Without implying that the other orders cannot sometimes be helped by extending quantitative enumerations and analyses to cover value, it is clear that the latter kind of statistics has much less to give than to receive.

To say that pecuniary statistics are less good than pecuniary statistics plus other kinds of related figures supporting them, is an affirmation of the obvious. Yet this fact needs emphasis. Pecuniary statistics greatly need such support. Nor is it quite true that the rule works equally well the other way. The pecuniary unit is the weak member which ought as little as possible to be left to stand alone. Stated values are seldom disinterested and their basis is never quite objective. We need always to know kinds and grades and their numbers or quantities, along with values. The foundation of all statistics should be in natural kinds or in the best obtainable substitutes for them.

III. Index Numbers [1]

By Wesley C. Mitchell

The Relations Between Methods and Uses

The first step, framing a clear idea of the ultimate use of the results, is most important, since it affords the clue to guide the compiler through the labyrinth of subsequent choices. It is, however, the step most frequently omitted.

When the end in view is specific and capable of precise statement the problem of choosing methods is comparatively simple. Straightforward logic then determines what commodities should be included, what sources of quotations should be drawn upon, and how the original data should be worked up to give the most significant results. Puzzles a-plenty are left, but most of them are

[1] "Index Numbers of Wholesale Prices in the United States and Foreign Countries," *Bulletin of the United States Bureau of Labor Statistics*, No. 173, pp. 25–78, 109–111. Reprinted by permission of the United States Bureau of Labor Statistics. In this reprint several footnotes, charts and tables have been omitted. [Editor.]

limited to finding the best compromise between what logic marks out as desirable and what is feasible in view of the time and money at the investigator's disposal.

Few of the widely-used index numbers, however, are made to serve one special purpose. On the contrary, most of them are "general-purpose" series, designed with no aim more definite than that of measuring changes in the price level. Once published they are used for many ends — to show the depreciation of gold, the rise in the cost of living, the alternations of business prosperity and depression, and the allowance to be made for changed prices in comparing estimates of national wealth or private income at different times. They are cited to prove that wages ought to be advanced or kept stable; that railway rates ought to be raised or lowered; that "trusts" have manipulated the prices of their products to the benefit or the injury of the public; that tariff changes have helped or harmed producers or consumers; that immigration ought to be encouraged or restricted; that the monetary system ought to be reformed; that natural resources are being depleted or that the national dividend is growing. They are called in to explain why bonds have fallen in price and why interest rates have risen, why public expenditures have increased, why social unrest prevails in certain years, why farmers are prosperous or the reverse, why unemployment fluctuates, why gold is being imported or exported, and why political "landslides" come when they do.

The compiler of a general-purpose index number, then, cannot foresee to what uses and misuses his figures will be put. For each of the legitimate uses he might conceivably devise an appropriate series. But he cannot conceivably devise a single series that will serve all uses equally well. For the very qualities that make an index number good, say, for the man of affairs concerned with the business outlook, may make it bad for other men interested in the fortunes of farmers, in the effects of the tariff, in the relation between gold output and prices, in comparing changes in price levels in different countries, etc. The day has not yet come when the uses of index numbers are sufficiently differentiated and standardized to secure the regular publication of numerous

special-purpose series. Until that day does come the making of general-purpose series will continue and the makers will go on choosing their methods perforce on rather vague and general grounds. So long also must most of the users of index numbers put up with figures imperfectly adapted to their ends.

The critical student of contemporary index numbers is in the same uncomfortable position as the compiler. He has no single rule of right and wrong to apply in judging the different general-purpose series, for methods that are legitimate for certain uses are questionable for others. Nevertheless, it is futile (though not uncommon) for him to discuss methods without reference to uses, since a statistical method has neither merits nor defects except as a means to certain ends. The one course that is open to him is to invert the problem. Instead of studying methods in the light of uses, he must study uses in the light of methods. That is, he must analyze the effect of the different methods followed in practice and so determine what the resulting figures mean and the uses to which they may properly be put.

The following discussion proceeds upon this plan. It deals primarily with the popular general-purpose series and endeavors to show how the various methods used in constructing these index numbers determine the uses to which they are severally adapted.

Collecting and Publishing the Original Quotations

The reliability of an index number obviously depends upon the judgment and the accuracy with which the original price quotations were collected. This field work is not only fundamental, it is also laborious, expensive, and perplexing beyond any other part of the whole investigation. Only those who have tried to gather from the original sources quotations for many commodities over a long series of years appreciate the difficulties besetting the task. The men who deal with data already published are prone to regard all this preliminary work as a clerical compilation requiring much industry but little skill. To judge from the literature about index numbers one would think that the difficult and important problems concern methods of weighting and averaging. But those who are practically concerned with the whole process of making

an index number from start to finish rate this office work lightly in comparison with the field work of getting the original data.

We commonly speak of *the* wholesale price of articles like pig iron, cotton, or beef as if there were only one unambiguous price for any one thing on a given day, however this price may vary from one day to another. In fact there are many different prices for every great staple on every day it is dealt in, and most of these differences are of the sort that tend to maintain themselves even when markets are highly organized and competition is keen. Of course varying grades command varying prices, and so as a rule do large lots and small lots; for the same grade in the same quantities, different prices are paid by the manufacturer, jobber, and local buyer; in different localities the prices paid by these various dealers are not the same; even in the same locality different dealers of the same class do not all pay the same price to everyone from whom they buy the same grade in the same quantity on the same day. To find what really was the price of cotton, for example, on February 1, 1915, would require an elaborate investigation, and would result in showing a multitude of different prices covering a considerable range.

Now the field worker collecting data for an index number must select from among all these different prices for each of his commodities the one or the few series of quotations that make the most representative sample of the whole. He must find the most reliable source of information, the most representative market, the most typical brands or grades, and the class of dealers who stand in the most influential position. He must have sufficient technical knowledge to be sure that his quotations are for uniform qualities, or to make the necessary adjustments if changes in quality have occurred in the markets and require recognition in the statistical office. He must be able to recognize anything suspicious in the data offered him and to get at the facts. He must know how commodities are made and must seek comparable information concerning the prices of raw materials and their manufactured products, concerning articles that are substituted for one another, used in connection with one another, or turned out as joint products of the same process. He must guard

against the pitfalls of cash discounts, premiums, rebates, deferred payments, and allowances of all sorts. And he must know whether his quotations for different articles are all on the same basis, or whether concealed factors must be allowed for in comparing the prices of different articles on a given date.

Difficult as it is to secure satisfactory price quotations, it is still more difficult to secure satisfactory statistics concerning the relative importance of the various commodities quoted. What is wanted is an accurate census of the quantities of the important staples, at least, that are annually produced, exchanged, or consumed. To take such a census is altogether beyond the power of the private investigators or even of the Government bureaus now engaged in making index numbers. Hence the compilers are forced to confine themselves for the most part to extracting such information as they can from statistics already gathered by other hands, and for other purposes than theirs. In the United States, for example, estimates of production, consumption, or exchange come from most miscellaneous sources: From the Department of Agriculture, the Census Office, the Treasury Department, the Bureau of Mines, the Geological Survey, the Internal Revenue Office, the Mint, associations of manufacturers or dealers, trade papers, produce exchanges, traffic records of canals and railways, etc. The man who assembles and compares estimates made by these various organizations finds among them many glaring discrepancies for which it is difficult to account. Such conflict of evidence when two or more independent estimates of the same quantity are available throws doubt also upon the seemingly plausible figures coming from a single source for other articles. To extract acceptable results from this mass of heterogeneous data requires intimate familiarity with the statistical methods by which they were made, endless patience, and critical judgment of a high order, not to speak of tactful diplomacy in dealing with the authorities whose figures are questioned. The keenest investigator, after long labor, can seldom attain more than a rough approximation to the facts. Yet it is only by critical use of the data now available that current index numbers can be weighted, and the best hope of improving weights in the future lies in

demonstrating not only the imperfections of our present statistics of production, consumption, and exchange, but also the importance of making them better.

When all this preliminary work has been done, the original quotations and the weights should be published at length. Unfortunately, many compilers of index numbers publish only the final results of their computations, upon the ground of expense or lack of interest in the detailed information. But much is sacrificed by taking this easy course. First, the reputation of the index number itself is compromised and deservedly. No one can really test whether a series is accurately compiled from representative quotations unless the data and their sources are given in full. Second, and more important, the publication of actual quotations greatly extends the usefulness of an investigation into prices. Men with quite other ends in view than those of the original compilers can make index numbers of their own adapted to their peculiar purposes if provided with the original data.

Nor is the importance of such unplanned uses to be rated lightly. If we are ever to make the money economy under which we live highly efficient in promoting social welfare we must learn how to control its workings. What wares our business enterprises produce and what goods our families consume are largely determined by existing prices, and the production and consumption of goods are altered by every price fluctuation. What we waste and what we save, how we divide the burden of labor and how we distribute its rewards, whether business enjoys prosperity or suffers depression, whether debts of long standing become easier or harder to pay — all these and many other issues turn in no small measure upon what things are cheap and what are dear, upon the maintenance of a due balance within the system of prices, upon the upward or downward trend of the price changes that are always taking place. But if the prices of yesterday are powerful factors in determining what we shall do and how we shall fare today, what we do and how we fare today are powerful factors in determining what prices shall be tomorrow. If prices control us we also control them. To control them so that they shall react favorably upon our economic fortunes we need more

insight than we have at present. It is, then, one of the great tasks of the future to master the complicated system of prices which we have gradually developed — to find how prices are interconnected, how and why they change, and what consequences each change entails. For when men have learned these things they will be vastly more skillful in mending what they find amiss in economic life, and in reënforcing what they find good. As yet our knowledge is fragmentary and uncertain. But of all the efforts being made to extend it none is so certain to prove fruitful as the effort to record the actual prices at which large numbers of commodities are bought and sold. For such data are the materials with which all investigators must deal, and without which no bits of insight can be tested. Indeed, it is probable that long after the best index numbers we can make today have been superseded, the data from which they were compiled will be among the sources from which men will be extracting knowledge which we do not know enough to find.

Market Prices, Contract Prices, and Import-Export Values

All the American index numbers are made from "market prices." These prices are usually obtained directly from manufacturers, selling agents, or wholesale merchants; from the records of produce exchanges and the like; or from trade journals and newspapers which make a specialty of market reporting in their respective fields.

Several of the important foreign index numbers are made wholly or partly from "import and export values"; that is, from the average prices of important articles of merchandise as officially declared by the importing or exporting firms, or as determined by governmental commissions. For example, Soetbeer's celebrated German series, and the British Board of Trade's official series are made mainly from such material, and the official French series was made wholly from import values until 1911.

A third source of quotations often drawn upon in Europe is the "contract prices" paid for supplies by such institutions as hospitals, normal schools, poorhouses, army posts, and the like. The official Italian series, Alberti's series for Trieste, and Levasseur's French series are examples.

These three classes of quotations — market prices, import and export values, and contract prices — usually differ somewhat, not only with respect to the prices prevailing on a given date, but also with respect to the degree of change from time to time. Accordingly it is desirable to inquire into the several advantages possessed by each source of quotations.

Contract prices may be set aside promptly, because index numbers made from them have a limited range of usefulness. Though the institutions whose records are drawn upon often make purchases on a considerable scale, yet the common description of their contract rates as "semi-wholesale" prices points to the peculiar and therefore unrepresentative character of such data. Moreover, there is often more doubt about the strictly uniform character of the supplies furnished to these institutions than about the uniformity of the standardized goods which are usually quoted in the market reports. If the aim of the investigation is to find the average variations in the cost of supplies to public institutions, doubtless contract prices are the best data to use. But if the aim is to measure the average variations in the wholesale prices paid by the business world at large, then market prices are distinctly the better source. Indeed, contract prices are seldom used for the latter purpose except when well-authenticated market quotations cannot be had.

The theory on which import and export values are sometimes preferred to market prices is that the former figures show more nearly the variations in the prices actually paid or received by a country for the great staples which it buys and sells than do market quotations for particular brands or grades of these commodities. For example, England buys several different kinds of cotton in proportions that vary from year to year. A price obtained by dividing the total declared values of all the cotton consignments imported by their total weight will show the average cost per pound actually paid by Englishmen for cotton with more certainty than will Liverpool market quotations for a single grade of cotton like "Middling American" — provided always that the "declared values" are trustworthy. Now, if the aim of the investigation is to find out the variations in the average

prices paid or received for staples — irrespective of minor changes in their qualities — then the preference for import and export values is clearly justified, again granted the trustworthiness of the returns. But if the aim is to measure just one thing — the average variation in prices — market prices for uniform grades are clearly better data. For index numbers made from import

TABLE I. COMPARISON OF INDEX NUMBERS MADE FROM IMPORT AND EXPORT VALUES WITH INDEX NUMBERS MADE FROM MARKET PRICES OF SAME COMMODITIES, BY YEARS, 1871 TO 1902

[Data from the British Board of Trade and from Sauerbeck.]

(Arithmetic means of relative prices. Average prices in 1890–1899 = 100. 25 commodities.)

Year	Import and export values	Market prices	Year	Import and export values	Market prices
1871	158	170	1887	104	107
1872	169	185	1888	108	110
1873	170	182	1889	108	110
1874	162	168	1890	109	111
1875	152	155	1891	111	111
1876	149	152	1892	105	103
1877	150	152	1893	103	104
1878	139	138	1894	95	94
1879	128	131	1895	93	94
1880	136	137	1896	94	93
1881	133	130	1897	93	91
1882	129	125	1898	95	95
1883	125	123	1899	101	105
1884	118	116	1900	114	117
1885	110	112	1901	107	106
1886	105	107	1902	104	104

and export values measure the net resultant of two sets of changes, and one cannot tell from the published figures what part of the fluctuations is due to changes in prices and what part is due to changes in the qualities of the goods bought and sold.

As might be expected import and export series generally pursue a more even course than market-price series. But this difference may be due less to the sources from which the quotations are obtained than to differences in the lists of commodities used. Fortunately, we can arrange a more certain test than any of the

common series provide. In 1903 the British Board of Trade published the average import or export prices of 25 commodities for which Mr. Sauerbeck has published market prices.[1] Index numbers made from these two sets of data for the same commodities for the years 1871 to 1902 are given in Table I. The results confirm the expectation: As compared with the import and export index number, the market-price index number starts on a higher level in 1871, falls to a lower point during the middle nineties, rises to a higher level in 1900, and again drops to as low a level in 1902.

Relative Versus Actual Prices

In February, 1864, Hunt's *Merchants' Magazine* published the following statement to show how rapidly prices rose after the suspension of specie payments in December, 1861, and the issue of the irredeemable United States notes.[2] These figures are the total prices of 55 articles quoted by their customary commercial units.

Value of 55 Leading Articles of New York Commerce

January, 1862	$804
April, 1862	844
January, 1863	1,312
March, 1863	1,524
July, 1863	1,324
October, 1863	1,455
January, 1864	1,693

For example, in January, 1862, coal oil is entered as 30 cents per gallon and pig iron as $24 per ton; molasses is entered as 42½ cents per gallon and whalebone as $69 per ton; oats is entered as 38 cents per bushel and corn as $59.25 per hundred bushels, etc.[3]

Clearly, this simple method of measuring changes in the price level by casting sums of actual prices is not trustworthy. For a relatively slight fall in the quotation for whalebone would affect the total, as Hunt's *Merchants' Magazine* computes it, much more than a relatively enormous increase in the price of molasses.

[1] . . . For Sauerbeck's figures see his annual articles in the *Journal of the Royal Statistical Society*. . . .

[2] Vol. 50, p. 132.

[3] See vol. 48, p. 129.

The fact that corn happens to be quoted by the hundred bushels makes a 1 per cent change from its price in January, 1862, equal to a 43 per cent change in the price of wheat and to a 156 per cent change in the price of oats, both of which are quoted by the bushel.

It was to avoid such patent absurdities that Carli threw his actual prices of grain, wine, and olives in 1750 into the form of percentages of rise or fall from their prices in 1500, and then struck the average of the three percentages. When this operation is performed it makes no difference whether the commodities are quoted by large or by small units. The obvious common sense of this precedent has caused it to be followed or reinvented by most makers of index numbers to this day — with one slight modification. To avoid the awkwardness of the plus and minus signs necessary to indicate whether prices have advanced or receded, it is usual to substitute for percentages of rise or fall relative prices on the scale of 100. For example, a rise of 10 per cent and a fall of 10 per cent are expressed by relatives of 110 and 90, respectively. Occasionally, however, percentages of rise or fall are still used as by Carli; as, for instance, in the chain relatives published by the Bureau of Labor Statistics in Bulletin No. 149. A second unimportant variant, long practiced by the *Economist*, but now seldom used, is to publish as the final result the sums of relative prices, instead of their averages.[1]

In recent years a few statisticians have gone back from the use of relative to the use of actual prices, adopting various devices to avoid such crude errors as those perpetrated in the figures cited from Hunt's *Merchants' Magazine*. In 1897 *Bradstreet's* began reducing all its original quotations by the gallon, ton, dozen, square yard, etc., to prices by the pound, and presenting as its index number the aggregate prices per pound of 98 articles.[2] Four years later, Dun's *Review* followed this lead, with an

[1] Gibson's index number is such a sum. The difference between sums of relative prices and these sums divided by the number of articles included is, of course, purely formal. Averages have displaced sums in current use mainly because it is easier to make comparisons on the scale of 100 than on the scale of 2,200, whatever number is given by the addition of relative prices.

[2] For a criticism of this method, see p. 95.

important difference. Instead of reducing actual quotations to quotations by the pound, it multiplied the actual quotation for each article included by the quantity of that article supposed to be consumed in the course of a year by the average individual. These products were then cast up, and the sums, in dollars and cents, were presented as an index number purporting to show the changes in the per capita cost of a year's supplies.[1]

Base Periods

When relative prices are used it is necessary to select the quotations of some given period as a base. The actual prices in this base period are called 100; all antecedent and subsequent prices are divided by the base prices, and the quotients, multiplied by 100, make the relatives which are usually summed and divided by the number of commodities to get the final index number.

In some cases the prices of a single day have been used as the base, but as a rule average prices for a year, five years, a decade, or an even longer period have been preferred. For this preference there is a simple justification when arithmetic means are used as averages of the relative prices. If the price of any commodity happens to be unusually high or unusually low in the base period, its relative prices at other periods will be correspondingly high or low, and very high relative prices, especially, may exercise an undue influence upon arithmetic means. If an appreciable proportion of the commodities in the list be very high or very low, the final index number may be distorted. Though numerically correct, the results have less significance than if they showed changes in terms of prices that men consider "normal." Of course exceptionally high or exceptionally low quotations are less likely to last for a year than for a day, and less likely to last for a decade than for a year.

The period chosen as base should be that period with which accurate comparisons are most significant for the purpose in hand. Probably most users of general-purpose index numbers prefer to make their comparisons with recent dates. Hence the

[1] The confidence merited by this index number is discussed on pp. 95–96.

case for " chain " indexes is very strong — that is, for indexes which show the average rise or fall of prices on the basis of prices in the preceding year. Hence, also, any index number with a fixed base becomes in one respect less significant the longer it is maintained. For example, when the Bureau of Labor Statistics' series was established in 1902, the public was interested to know how much prices in that year had changed in terms of average prices in the decade 1890–1899. In 1915, however, we care less about a measurement of change in terms of what prices were 16 to 25 years ago than we care about how much prices have changed with reference to 1914. Similarly, Sauerbeck's index number suffers in significance now because it forces one to make all comparisons in terms of prices in a period that ended before most of the people now living were old enough to know the meaning of prices.

A further advantage of chain index numbers is that they make the dropping of obsolescent and the adding of new commodities especially easy. It is difficult to keep the list of commodities included in a fixed-base system really representative of the markets over a long period of time. Barring perhaps thirty or so staple raw materials that hold their importance for centuries at a time, most commodities have their day of favor and then yield to new products. Consequently the compilers can hardly let two decades pass without revising their lists, in certain details, or seeing them lose in significance. But since a chain index does not profess to give accurate comparisons except between successive years the compiler feels himself free to improve his list whenever he can. It is very much easier to include many commodities on this plan. And if the index number be weighted, the chain index has a similar advantage in facilitating the frequent revision of the weights.

Once more, year-to-year variations of prices can be measured with a closer approach to accuracy than variations covering a longer period of time. For the former variations are highly concentrated about their central tendency while the variations from what prices used to be years ago are widely dispersed. The longer a fixed-base system is maintained, indeed, the more scattered

become the relative prices as a rule. Hence the variations are less and less aptly represented by any average that can be devised, and the margin of error to which the results are subject grows wider. In other words, with a given body of quotations to build upon, chain relatives are more trustworthy than their rivals; and, as has just been said, it is feasible to provide a larger body of quotations for chain relatives than for a fixed-base series.

Finally, another aspect of the wide dispersion that becomes characteristic of fixed-base relatives with the lapse of years merits separate mention. The commodities that have a consistent long-period trend gradually climb far above or fall far below the average relative prices. Then the high relative prices of the first group come to exercise much more influence upon the position of the average itself than do the low relative prices of the second group. A 10 per cent change in the price of an article whose price has already doubled will count four times as much as a 10 per cent change in the price of an article whose price has dropped by half. For most purposes, this development is to be regarded as a defect of the fixed-base series. For commodities seldom gain in importance because of a great rise in price; on the contrary, the commodities that become cheaper are likely to be consumed and produced on an increasing scale. Against this danger of magnifying the influence of articles that are becoming costly and minimizing the influence of articles that are becoming cheap, no care in the selection of a base avails for long if the base be fixed.

Chain relatives have their drawbacks also. Makers of index numbers find them more laborious to compute than fixed-base series, since most of the actual prices used as divisors change every year. And users of index numbers find a chain series difficult to interpret when they seek to know how much prices have risen or fallen over considerable periods of time. Of course, chain relatives for successive years can be multiplied together to form a continuous series, but it is not easy to give the later members of the series a concrete meaning. To know, for example, that in 1891 prices fell, on the average, 0.2 per cent below their level in 1890; that in 1892 they fell 4.4 per cent below their new level in

1891, and so on through ups and downs on an ever-changing base for every year to 1915, enables one to make a series beginning, say, with 100 in 1890 and running on with 99.8 in 1891, 95.4 in 1892, etc., to some result for 1915.[1] But such a series does not enable one to say in terms of what a comparison is made between prices in 1915 and in 1890. Any fixed-base series covering these years, on the contrary, would show the level of prices both in 1890 and in 1915 in terms of a common denominator — namely, the level at which prices stood in the base period, whatever that was. Hence it is an excellent plan to make from the original quotations two series of index numbers — one a chain index and the other a fixed-base series.

Even this combination, however, is far from meeting all the needs of users of index numbers. For certain users may require for special purposes accurate measurements of price fluctuations in terms of the price level in any given month or year, or any given stretch of time in the whole period covered by the investigation. If such users are few as compared with all the people who note or quote the popular index numbers, they are precisely the few most interested in price fluctuations and most likely to increase knowledge by their use of the figures. But of course compilers cannot foresee what base periods would serve best all these special purposes, and they cannot be expected to work out index numbers on all the bases made possible by their original data. It is therefore highly desirable to have index numbers that can be shifted from one base to another both readily and accurately.

It is this desideratum, in large part, that has led to the recent reaction against index numbers made by striking arithmetic means of relative prices and in favor of index numbers made by adding actual prices. For the latter form of index, being a sum of dollars and cents, can be thrown into the form of a series of relative prices upon any base that is desired, with slight labor and without inaccuracy; whereas arithmetic means of relative prices cannot consistently be shifted to a new base without recomputing the relative prices, commodity by commodity, and striking new averages from these new relatives. Such recomputations are so

[1] For an example of this method, see pp. 70–71.

laborious that a short method of shifting the base of this kind of index numbers is often practiced even by persons quite aware of the ambiguity of the new results. This method consists in dividing the figures for other dates by the figures for the date desired as base and multiplying the quotients by 100. Of course this process results in a relative price of 100 for the new base period, and the other figures look as if they showed average relative prices as percentages of prices at this period. But there is no mathematical justification for assuming that results reached in this way must agree with results reached by recomputing relative prices for each commodity on the new base. For such recomputation usually alters considerably the relative influence exercised upon the arithmetic means by the price fluctuations of certain commodities. Those articles which are cheaper in the new than in the old base period get higher relative prices and therefore increased influence. Vice versa, articles that are dearer in the new base period get lower relative prices and therefore diminished influence. Of course the short method of shifting the base, which retains the old relative prices, does not permit any such alteration in the influence exercised by the fluctuations of different commodities. Hence the two methods of shifting the base seldom yield precisely the same results. To present a series of arithmetic means shifted by the short method as showing what the index numbers would have been if they had been computed upon the new base is therefore misleading.

It is easy to arrange examples in which wide discrepancies appear between the results of the two methods of shifting the base. But the difficult and the important thing is to find out how serious the discrepancies are in actual practice. For to use index numbers effectively, it is often necessary to shift the base, and sometimes the short method must be followed, either because recomputation in full requires a prohibitive amount of labor, or because the original data necessary for recomputation have not been published. The next table gives three pertinent examples. In the first case when Sauerbeck's index is shifted from 1867–1877 = 100 to 1890–1899 = 100 the discrepancies are fairly regular and rather small both absolutely and relatively. In the

last case, when the same series is shifted to 1860 = 100, the discrepancies are highly irregular from year to year, and are rather large both absolutely and relatively — several times exceeding 5 per cent of the recomputed figures. In the remaining case the discrepancies are small absolutely, though often large relatively to the recomputed figures, and also highly variable from year to year.[1] The conclusion which these experiments suggest is that the two methods almost always give different results; that the discrepancies are by no means constant from year to year in a given case, and that their magnitude both absolutely and relatively differs much from one case to another. Hence it is well to avoid the short method of shifting bases whenever possible; and when that method must be used, its results should not be treated as showing what the index number would have been had it been made originally on the new base.

The second of the preceding examples of discrepancies arising from the two ways of shifting bases merits especial attention because it refers to the new and important chain index number published by the Bureau of Labor Statistics in Bulletin No. 149. All of the "percentages of increase or decrease compared with each preceding year or month" on pages 9 to 16 of Bulletin No. 149 were made by dividing the 1890–1899 index number for each date by the corresponding index number for the preceding date. Consequently these results are not precisely what the captions, under which they appear, suggest. The fact that the discrepancies between the two sets of results are small, never exceeding 1.5 points in the scale of percentage changes, affords striking confirmation of a conclusion drawn in Section III from the dis-

[1] The discrepancies shown in the table do not result wholly from the mathematical inconsistency of the short method; but partly from the fact that when an index number is shifted to a new base by recomputation in full it is commonly impossible or undesirable to utilize all the original data. Some commodity, for example, may not be quoted for the dates used as the new base, and therefore has either to be dropped or introduced at a later date by means of some doubtful assumption as to what its price would have been had it been quoted for the full period. Of course this observation makes the objection to using the short method stronger rather than weaker. It means that this method often leads the statistician into uses of the original data which he would have avoided had he undertaken the recomputation of the index number.

tribution of price variations.[1] Because variations from prices in the preceding year are highly concentrated about a central

TABLE II. EXAMPLES OF DISCREPANCIES BETWEEN RESULTS OF TWO METHODS OF SHIFTING BASES ON WHICH INDEX NUMBERS ARE COMPUTED

(Arithmetic means)

	Sauerbeck's index number 1890–1913				Bureau of Labor Statistics' index number					Sauerbeck's index number 1860–1891			
Years	Original form, 1867–1877 = 100	Shifted to 1890–1899 = 100, by short method	Recomputed on basis 1890–1899 = 100, by long method	Discrepancies	Bureau's series on basis 1890–1899 = 100	Chain index made by short method	Chain index made by long method	Discrepancies	Years	Original form, 1867–1877 = 100	Shifted to 1860 = 100, by short method	Recomputed on basis 1860 = 100	Discrepancies
1890	72	109	109	..	112.9	....	....	....	1860	99	100.0	100.0	....
1891	72	109	109	..	111.7	−1.1	− 0.2	0.9	1861	98	99.0	99.6	0.6
1892	68	103	103	..	106.1	−5.0	− 4.4	.6	1862	101	102.0	105.5	3.5
1893	68	103	103	..	105.6	− .5	− .2	.3	1863	103	104.0	109.3	5.3
1894	63	95	95	..	96.1	−9.0	− 8.7	.3	1864	105	106.1	112.3	6.2
1895	62	94	94	..	93.6	−2.6	− 1.5	1.1	1865	101	102.0	105.8	3.8
1896	61	92	92	..	90.4	−3.4	− 2.8	.6	1866	102	103.0	106.5	3.5
1897	62	94	93	1	89.7	− .8	+ .2	.4	1867	100	101.0	103.9	2.9
1898	64	97	97	..	93.4	+4.1	+ 4.8	.7	1868	99	100.0	103.1	3.1
1899	68	103	104	1	101.7	+8.9	+10.4	1.5	1869	98	99.0	101.9	2.9
1900	75	114	115	1	110.5	+8.7	+ 9.4	.7	1870	96	97.0	100.3	3.3
1901	70	106	107	1	108.5	−1.8	− 1.1	.7	1871	100	101.0	102.6	1.6
1902	69	105	106	1	112.9	+4.1	+ 4.6	.5	1872	109	110.1	112.5	2.4
1903	69	105	106	1	113.6	+ .6	+ 1.2	.6	1873	111	112.1	116.6	4.5
1904	70	106	108	2	113.0	− .5	− .1	.4	1874	102	103.0	107.0	4.0
1905	72	109	111	2	115.9	+2.6	+ 2.9	.3	1875	96	97.0	100.3	3.3
1906	77	117	119	2	122.5	+5.7	+ 5.8	.1	1876	95	96.0	97.5	1.5
1907	80	121	123	2	129.5	+5.7	+ 6.0	.3	1877	94	95.0	97.4	2.4
1908	73	111	112	1	122.8	−5.2	− 5.6	.4	1878	87	87.9	91.2	3.3
1909	74	112	114	2	126.5	+3.0	+ 3.2	.2	1879	83	83.8	86.7	2.9
1910	78	118	120	2	131.6	+4.0	+ 4.1	.1	1880	88	88.9	91.8	2.9
1911	80	121	123	2	129.2	−1.8	− 1.9	.1	1881	85	85.9	88.5	2.6
1912	85	129	130	1	133.6	+3.4	+ 3.4	....	1882	84	84.9	88.0	3.1
1913	85	129	130	1	135.2	+1.2	+ 1.2	....	1883	82	82.8	86.0	3.2
									1884	76	76.8	79.3	2.5
									1885	72	72.7	75.4	2.7
									1886	69	69.7	72.4	2.7
									1887	68	68.7	70.7	2.0
									1888	70	70.7	73.9	3.2
									1889	72	72.7	76.7	4.0
									1890	72	72.7	76.0	3.3
									1891	72	72.7	75.4	2.7

tendency, while variations from the prices of a remoter period are widely scattered, it was argued that the measurement of price changes is easy in proportion as the time during which these

[1] *Bulletin of the United States Bureau of Labor Statistics*, No. 173, pp. 10–24. [Ed.]

changes have been accumulating is short. So, now, we find that dissimilar methods of manipulating the same data yield nearly the same results when they are applied to the easy problem of making a chain index number.

The use of the short method in making the new chain indexes was the natural result of a practice begun by the bureau in 1908 — a practice that illustrates, from another angle, the problem of shifting bases. In that year 11 new commodities were introduced into the bureau's index number. Since quotations were not secured for these commodities prior to 1907, relative prices could not be computed for them on the 1890–1899 base. How, then, could these new articles be included in the index numbers of the groups affected? The bureau solved this problem by (1) computing relative prices for both the new and the old commodities in 1908 on the basis, prices in 1907 = 100, (2) averaging these relatives, and (3) shifting these new index numbers for 1908 from the 1907 base to the 1890–1899 base. This shift was effected by multiplying the group index numbers for 1908, on the 1907 base, by the group index numbers for 1907, on the 1890–1899 base.

The process may be illustrated from the group of farm products. The index number for this group in 1907, on the base, prices in 1890–1899 = 100, was 137.1, while in 1908, on the base, prices in 1907 = 100, the index number was 97.1. The bureau assumed that since prices of farm products in 1908 were, on the average, 97.1 per cent of their prices in 1907, and since their prices in 1907 had been 137.1 per cent of their prices in 1890–1899, therefore prices in 1908 were 97.1 per cent of 137.1 per cent of prices in 1890–1899; that is, 133.1 per cent of prices in 1890–1899. By repeating this process in later years, the bureau forged its successive chain indexes from 1908 to 1913 into a continuous series.

The merits and defects of series made in this fashion have already been canvassed. The one fact important for present purposes is that the results of this method, however excellent in other ways, do not agree with results worked out on a fixed-base system. Hence the bureau's present index numbers of farm products, foods, and lumber and building materials — the three groups into which new commodities were introduced — are not

accurately comparable in 1908–1913 either with its figures for these same groups in 1890 to 1907, or with its 1908–1913 figures for the six remaining groups. Even the general index number of all commodities is affected appreciably by the admission of the inconsistent elements into the grand totals from which averages were struck.

The question remains: How much difference did the change in method make? To answer one must find a better way of introducing the 11 new commodities into the old list. To effect this introduction, some assumption is necessary concerning the relation of their prices in 1907, the first year for which quotations were obtained, to their unknown prices in the base period. Perhaps the bureau's implicit assumption that the 1907 index number of the old commodities on the 1890–1899 base should be taken as the starting point for computing relative prices for the new commodities is as defensible as any other guess that can be made. If this guess be accepted, the relative prices for the four new farm products should be computed on the base, actual prices in 1907 = 137.1; for the six new foods on the base, actual prices in 1907 = 117.8, and for the one new kind of lumber on the base, actual prices in 1907 = 146.9. Then the relatives for the new commodities can be added to and averaged with the relatives for the old without more ado. If this method be applied to farm products the result is an index number for 1908 of 133.4, whereas the bureau's method gives 133.1. In the case of foods we get 121.5 instead of the bureau's 120.6, and in the case of lumber and building materials 131.8 instead of 133.1.

Now the discrepancies between these two sets of results for 1908 seem small. But the bureau soon made them large, by building its index for 1909 on the discrepancy for 1908, again building in 1910 on the discrepancy accumulated in 1908 and 1909, and so on. By 1913 the results of the two methods for farm products are far apart; the two figures for food products and for lumber and building materials are seriously at variance, and even the general index numbers for all commodities show a difference of 4.2 points.

The Numbers and Kinds of Commodities Included

Since the earlier makers of index numbers had to use such price quotations as they could find, the problems how many and what kinds of commodities to include were practically solved for them. As Professor Edgeworth remarks, " Beggars cannot be choosers."

Paucity of data still hampers contemporary efforts to measure variations of prices in the past; but the compilers of index numbers for current years have a wider range of choice. The scope of their data is limited not by the impossibility but by the expense of collecting quotations. And in the case of governmental bureaus or financial journals the limits set by expense are neither narrow nor rigid. Such organizations can choose many commodities if they will or content themselves with few.

One principle of choice is generally recognized. Those commodities are preferable that are substantially uniform from market to market and from year to year. Often the form of quotation makes all the difference between a substantially uniform and a highly variable commodity. For example, prices of cattle and hogs are more significant than prices of horses and mules, because the prices of cattle and hogs are quoted per pound, while the prices of horses and mules are quoted per head.

It is often argued that the application of this common-sense principle rules out almost all manufactured goods, because such articles are continually being altered in quality to suit the technical exigencies of new industrial processes or the varying tastes of consumers. But minor changes in quality, provided their occurrence is known, do not necessarily unfit a commodity for inclusion. When the brand formerly sold is replaced by a variant it is usually possible to get over-lapping quotations for the old and new qualities during the time of transition. Then the new series may be spliced upon the old by means of the ratio borne by the price of the new grade to the price of the old grade in the years when the substitution is made. Statisticians willing to take the extra precautions and trouble involved by such operations can legitimately include not only a large number of staple raw materials and their simplest products, but also an even larger number of manufactured goods.

Some of the modern index numbers, accordingly, have long lists of commodities. Dun's index number seems to be built up from 310 series of quotations, the official Canadian index number includes 272 articles, the Bureau of Labor Statistics' index number for 1913 had 252, and the new weighted index number for 1914 contains 297 quotations of 201 distinct articles. On the other hand, many of the best-known index numbers use less than 50 series of quotations. Forty-five is a favorite number, largely because of the high reputation early established by Sauerbeck's English series. The British Board of Trade's series, the new official French series, the New Zealand series, Von Jankovich's Austrian series, and Atkinson's series for British India, all have just 45 commodities, while the new series of the London Economist and the relative prices published by the Imperial Statistical Office of Germany include 44 articles. Even shorter lists are often used. For example, Schmitz's German series has only 29 commodities, the New York Annalist series, 25, and Gibson's series, 22. Private investigators working with limited resources sometimes confine themselves to a bare dozen commodities, or even less.[1]

These differences of practice raise important questions of theory. Does it make any substantial difference in the results whether 25 or 50 or 250 commodities be included — provided always that the lists be well chosen in the three cases? If differences do appear in the results, are they merely haphazard, or are they significant differences? If there are significant differences, which set of results is more valuable, that made from the long or from the short lists? And what does the proviso that the lists be well-chosen mean? In short, do the index numbers including hundreds of commodities possess any real advantages over those

[1] These statements refer to the number of series of relative prices averaged to get the final results as now presented. Often two or more different varieties of an important article are counted as separate commodities, and, on the other hand, the relative prices of slightly different articles are sometimes averaged to make one of the series which enters into the final averages. In view of the diversity of practice in this respect, a perfectly consistent counting of the number of distinct "commodities" included in the general series is impossible. Moreover, the figures are often published with such imperfect explanations as to make the counting of the commodities included doubtful or impossible on any interpretation of that term.

including 50 or 25 to compensate for the greater trouble and expense of compiling them ?

The best way to answer these questions is to experiment with large and small index numbers, made on a strictly uniform plan for the same country and the same years. Table III presents six such index numbers which differ only in respect to the number and kind of commodities included. The first column includes all the commodities quoted by the Bureau of Labor Statistics, except the 11 whose prices do not run back of 1908.[1] Many of the commodities in this list are merely different varieties of the same article; for example, there are two kinds of corn meal, four kinds of leather, six kinds of women's dress goods, eleven kinds of steel tools, etc. The second column gives an index number in which all such groups are represented by single averages, so that the number of series which enter directly into the final results is cut down to 145.[2] The third column, which includes 50 commodities, is made up from the list adopted for the Gibson index number in its original form.[3] The fourth series is made from the prices of 20 pairs, each commodity being given in two forms, raw and manufactured, e. g., barley and malt, cattle and beef, copper ingots and copper wire, etc. The last two columns contain index numbers each made from the prices of 25 important articles selected at random, the two lists having no items in common.[4]

Now, these six index numbers, large and small, certainly have a strong family likeness. The great movements of American prices since 1890 stand out boldly in them all — the heavy fall of prices in 1890–1896, the distinctly greater rise in 1896–1907, the sharp decline in 1908, the recovery in 1909, and the wavering course in 1910–1913. If index numbers could pretend to nothing more than to show roughly the trend of price fluctuations, then it would indeed matter little which of these series were used. Either

[1] To facilitate comparison, decimals have been dropped and the index for each year rounded off to the nearest whole number. Further, the results for 1908–1913 are changed for the reasons explained on pp. 70–71. Regarding the changes in the number of commodities included, see Bulletin No. 149, p. 11.

[2] For the list of 145 commodities see *Bulletin of the United States Bureau of Labor Statistics*, No. 173, p. 47. [Editor.]

[3] *Ibid.* [4] *Ibid.*

TABLE III. SIX INDEX NUMBERS FOR THE UNITED STATES MADE FROM QUOTATIONS FOR DIFFERENT NUMBERS OF COMMODITIES, BY YEARS, 1890 TO 1913.

(Arithmetic means. Average prices in 1890–1899 = 100)

Year	242 to 261 commodities	145 commodities	50 commodities	40 commodities	25 commodities, first list	25 commodities, second list
1890	113	114	114	113	115	113
1891	112	113	114	114	112	118
1892	106	106	105	105	103	112
1893	106	105	105	101	103	107
1894	96	96	94	93	92	96
1895	94	93	94	95	95	93
1896	90	89	87	88	88	85
1897	90	89	89	89	90	84
1898	93	93	95	95	96	90
1899	102	103	103	108	107	103
1900	111	111	112	115	113	109
1901	109	110	109	116	111	107
1902	113	114	116	122	116	117
1903	114	114	115	118	118	117
1904	113	114	116	118	122	110
1905	116	116	118	122	123	115
1906	123	122	123	128	130	122
1907	130	130	132	138	132	132
1908	122	121	125	129	124	122
1909	125	124	132	135	133	128
1910	130	131	135	141	133	134
1911	126	130	129	135	129	131
1912	130	134	138	142	140	138
1913	130	131	138	139	142	133
Averages 1890–1899	100	100	100	100	100	100
1900–1909	118	118	120	124	122	118
1910–1913	129	132	135	139	136	134
Number of points by which prices rose (+) or fell (−) in—						
1890–1896	−23	−25	−27	−25	−27	−28
1896–1907	+40	+41	+45	+50	+44	+47
1907–1908	− 8	− 9	− 7	− 9	− 8	−10
1908–1912	+ 8	+13	+13	+13	+16	+16
Difference between highest and lowest relative prices	40	45	51	54	54	54
Average change from year to year	4.0	4.1	4.9	5.5	5.0	6.2

of the sets including only 25 commodities would serve that limited purpose as well as the set containing nearly ten times as many commodities, though doubtless the longer lists would command more confidence.

But the very success with which index numbers, even when made from scanty and dissimilar data, bring out the broader features of price movements encourages one to hope, from this device, for more than an indication of the direction and a rough approximation to the degree of change. Instead of concluding that an easy compilation, based on a few series of quotations "will do," we may hope that careful work covering a wide field will enable us to improve upon our first results and attain measurements that have a narrow margin of error.

When we make these more exacting demands upon our six index numbers we attach importance to the fact that their general similarity does not preclude numerous differences of detail. For example, two series indicate that prices rose in 1891, one indicates that prices did not change, and three indicate a fall; three put the lowest point in 1896, one in 1897, and two make the price level the same in these years; one series shows a rise in 1901, five show a fall; in 1913 again one series indicates a rise of prices, three indicate a fall, and two indicate no change; the general level of prices in the final year is made to vary between an average rise of 30 per cent and one of 42 per cent above the level of 1890–1899; there is also a difference in steadiness, the small series fluctuating through a wider range than the large ones, etc.

To what are these discrepancies due? Are they discreditable to the large series, or to the small ones, or to neither set? Can they be accounted for except as the results of random differences in sampling?

If an index number made from the wholesale prices of 25, or 50, or 250 commodities can measure approximately the changes in all wholesale prices, it must be because the known fluctuations in the prices of these selected commodities are fair samples of the unknown fluctuations in the prices of the vastly larger number of other commodities for which quotations are not collected. Now if (1) the price fluctuations of each commodity that is bought and

sold were strictly independent of the price fluctuations of every other commodity, and if (2) each commodity had just the same importance as an element in the general system of prices as every other commodity, then any series of price quotations collected at random would be a fair sample for determining the average changes in the wholesale prices of commodities in general. Of course, the larger the number of commodities included, the more trustworthy would be the index number. In Table III, for example, the first index number would be adjudged the best, and the divergencies between it and its fellows would be held to result from the scantier material from which the latter are made.

In fact, however, the situation is by no means so simple, because neither of the above-mentioned conditions holds true. Commodities are far from being all of the same importance as elements in the whole system of prices. With the complications arising from this fact the section on the problems of weighting will deal. Neither are the price fluctuations of different commodities independent of each other. On the contrary, the price changes of practically every commodity in the markets of the whole country are causally related to the changes in the prices of a few or of many, perhaps in the last resort of all other commodities that are bought and sold. Most of these relations are so slight that they cannot be traced by statistical methods. But certain bonds are so close and so strong that they establish definite groups of related prices which fluctuate in harmony with one another and which differ in definable ways from the fluctuations of other such groups. The present task is to show the existence of these groups and the effects which they exercise upon index numbers.

First, the price fluctuations of a raw material are usually reflected in the prices of its manufactured forms. Hence to quote in some cases both the raw material and several of its finished products, and to quote in other cases the raw material alone, assigns certain groups of related prices a larger influence upon the results than is assigned the other groups. When the aim is to secure a set of samples which fairly represent price fluctuations as a whole, the existence of these groups must be taken into account.

Neglect on this score may give a misleading twist to the final index numbers. A celebrated case in point is that of the Economist index number in 1863–1865. Out of the 22 commodities included in the Economist's list as then constituted 4 consisted of cotton and its products. Hence when the blockade of Southern ports during the Civil War raised the price of cotton, the Economist index numbers grossly exaggerated the average rise in the price level, as appears from the following comparison between the Economist's results for 1860–1865 and the corresponding English figures compiled by Sauerbeck:[1]

Year	Economist index number (prices in 1860 = 100)	Sauerbeck's index number (prices in 1860 = 100)
1860	100	100
1861	102	100
1862	109	106
1863	136	109
1864	145	112
1865	136	106

Directly opposing the relations which unite the prices of finished goods with the prices of their raw materials is a second set of influences which make the price fluctuations of manufactured goods considered as a group characteristically different from the price fluctuations of their raw materials considered as a separate group. Table IV presents several sets of index numbers designed to throw these characteristic differences into high relief. The first two columns compare the relative prices of the 49 raw materials quoted by the Bureau of Labor Statistics and of the 183 to 193 more or less manufactured commodities in its list. The second pair of columns contains index numbers made from the prices of 20 raw materials and of 20 products manufactured from these same materials. Then come three columns giving index numbers made from the prices of five great staples at three successive stages of manufacture: Wheat, flour, and bread; cotton, cotton yarns, and cotton textiles; wool, worsted yarns,

[1] To make the comparison as fair as possible, both series are here given, not in their original form, but recomputed on a common basis. See *Wholesale Prices, Wages, and Transportation*, report by Mr. Aldrich from the Committee on Finance, March 3, 1893, 52d Cong., 2d sess., Senate Report No. 1394, Part I, pp. 226 and 255.

TABLE IV. INDEX NUMBERS MADE FROM PRICES OF RAW MATERIALS AND OF MANUFACTURED GOODS, 1890 TO 1913.

[Data from the Bulletin of the Bureau of Labor Statistics, No. 149. Arithmetic means. Average prices in 1890–1899 = 100]

Year	49 raw materials	183 to 193 manufactured products	Twenty pairs: Raw materials	Twenty pairs: Manufactured goods	Five triplets: Raw materials	Five triplets: Intermediate products	Five triplets: Finished goods	Wheat group: Wheat	Wheat group: Wheat flour	Wheat group: Bread	Cotton group: Raw cotton	Cotton group: Cotton yarns	Cotton group: Cotton textiles	Wool group: Raw wool	Wool group: Worsted yarns	Wool group: Woolen textiles	Iron group: Pig iron	Iron group: Steel billets	Iron group: Steel tools	Leather group: Hides	Leather group: Leather	Leather group: Shoes
Number of commodities included	...	...	...	...	...	...	...	*1*	*2*	*2*	*1*	*2*	*24*	*2*	*2*	*16*	*4*	*1*	*11*	*1*	*4*	*3*
1890	115	112	113	112	125	119	108	119	121	101	143	112	117	132	122	111	131	142	107	100	101	106
1891	116	111	114	114	117	116	107	128	126	101	111	113	112	126	123	112	116	118	106	102	101	104
1892	108	106	104	105	103	109	106	105	104	101	99	117	111	113	117	112	106	110	105	93	97	103
1893	104	106	99	103	95	100	105	90	89	101	107	111	109	102	110	109	96	95	103	80	97	101
1894	93	97	91	94	79	86	98	74	78	101	90	93	98	79	91	96	83	77	99	68	92	99
1895	92	94	94	96	89	89	95	80	84	98	94	92	94	70	74	88	91	86	95	110	108	100
1896	84	92	85	92	87	88	95	85	91	97	102	93	95	71	73	87	88	88	96	87	95	101
1897	88	90	88	89	94	90	94	106	110	101	92	91	90	89	83	90	78	70	95	106	96	96
1898	94	93	98	92	101	95	95	118	109	101	77	91	85	108	101	98	77	71	94	123	104	94
1899	106	101	114	103	111	107	98	95	88	101	85	89	91	111	107	100	134	145	101	132	109	95
1900	112	110	118	111	120	110	105	94	88	101	124	116	103	118	118	111	140	116	112	127	113	98
1901	111	108	120	113	110	102	102	96	87	101	111	98	99	97	102	105	112	112	110	132	111	96
1902	122	111	127	118	123	110	103	99	90	101	115	94	100	101	112	106	155	142	115	143	113	96
1903	123	112	122	114	125	114	106	105	97	101	145	113	105	110	118	111	141	130	118	125	112	96
1904	120	111	123	113	128	115	110	138	125	106	156	120	114	116	117	112	104	103	118	124	109	98
1905	121	115	127	117	132	115	114	135	122	110	123	106	107	127	125	119	124	112	128	153	112	106
1906	127	122	135	120	136	119	121	106	97	110	142	121	117	121	129	125	145	128	134	165	120	119
1907	133	129	146	131	145	126	125	121	109	110	153	134	133	122	128	124	175	136	138	155	124	120
1908	124	121	135	124	130	117	120	132	119	113	135	109	116	118	118	121	125	122	134	143	119	114
1909	131	123	143	127	149	126	121	160	139	116	156	119	117	127	130	122	127	114	129	176	127	121
1910	135	129	149	132	149	125	124	146	126	118	195	133	127	116	124	124	124	118	131	165	125	118
1911	135	124	144	127	135	115	120	131	112	118	168	125	125	108	116	120	112	100	123	158	121	116
1912	145	127	151	132	141	119	124	140	122	122	148	120	122	111	119	123	118	104	124	188	129	127
1913	139	128	149	128	143	122	127	127	109	123	165	132	126	105	113	123	122	120	126	196	139	137
Averages, 1890–1899	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1900–1909	122	116	130	119	130	115	113	119	107	107	136	113	111	116	120	116	135	122	124	144	116	106
1910–1913	139	127	148	130	142	120	124	136	117	120	169	128	125	110	118	123	119	111	126	177	129	125
Number of points by which prices rose (+) or fell (−) in —																						
1890–1896	−31	−20	−28	−20	−38	−31	−13	−34	−30	− 4	−41	−19	−22	−61	−49	−24	−43	−54	−11	−13	− 6	− 5
1896–1907	+49	+37	+61	+39	+58	+38	+30	+36	+18	+13	+51	+41	+38	+51	+55	+37	+87	+48	+42	+68	+29	+19
1907–1908	− 9	− 8	−11	− 7	−15	− 9	− 5	+11	+10	+ 3	−18	−25	−17	− 4	−10	− 3	−50	−14	− 4	−12	− 5	− 6
1908–1913	+15	+ 7	+14	+ 4	+13	+ 5	+ 7	− 5	−10	+10	+30	+23	+10	−13	− 5	+ 2	− 3	− 2	− 8	+53	+20	+23
Difference between highest and lowest relative prices	61	39	66	43	70	40	33	86	61	26	118	45	48	62	57	38	98	75	44	128	47	43
Average change from year to year	5.5	4.0	6.4	4.9	8.4	5.5	3.1	13.6	11.6	1.3	18.1	9.8	6.1	9.1	8.1	3.9	17.5	16.0	3.7	14.7	5.0	3.7

and woolen textiles; pig iron, steel billets, and steel tools; hides, leather, and shoes. The later sections of the table give the data for each of these last-mentioned groups separately. These several comparisons establish the conclusion that manufactured goods are steadier in price than raw materials. The manufactured goods fell less in 1890–1896, rose less in 1896–1907, again fell less in 1907–1908, and rose less in 1908–1913. Further, the manufactured goods had the narrower extreme range of fluctuations, the smaller average change from year to year, and the slighter advance in price from one decade to the next. It follows that index numbers made from the prices of raw materials, or of raw materials and slightly manufactured products, must be expected to show wider oscillations than index numbers including a liberal representation of finished commodities.

Third, there are characteristic differences among the price fluctuations of the groups consisting of mineral products, forest products, animal products, and farm crops. Table V presents index numbers for these four groups. Fifty-seven commodities are included, all of them raw materials or slightly manufactured products.[1] Here the striking feature is the capricious behavior of the prices of farm crops under the influence of good and bad harvests. The sudden upward jump in their prices in 1891, despite the depressed condition of business, their advance in the dull year 1904, their fall in the year of revival 1905, their failure to advance in the midst of the prosperity of 1906, their trifling decline during the great depression of 1908, and their sharp rise in the face of reaction in 1911 are all opposed to the general trend of other prices. The prices of animal products are distinctly less affected by weather than the prices of vegetable crops, but even they behave queerly at times, for example in 1893. Forest-product prices are notable chiefly for maintaining a much higher level of fluctuation in 1902–1913 than any of the other groups, a level on which their fluctuations, when computed as percentages of the much lower prices of 1890–1899, appear extremely violent. Finally, the prices of minerals accord better with alternations of

[1] For list see *Bulletin of the United States Bureau of Labor Statistics*, No. 173, p. 58. [Editor.]

TABLE V. INDEX NUMBERS MADE FROM PRICES OF MINERAL, FOREST, ANIMAL, AND FARM PRODUCTS, BY YEARS, 1890 TO 1913.

[Data from the Bulletin of the Bureau of Labor Statistics, No. 149]

(Arithmetic means. Average prices in 1890–1899 = 100)

Year	Mineral products	Forest products	Animal products	Farm crops
Number of commodities included	*19*	*10*	*10*	*18*
1890	119	107	106	119
1891	111	105	108	126
1892	105	99	109	110
1893	98	98	116	105
1894	87	95	94	101
1895	91	96	95	92
1896	92	94	82	76
1897	88	95	88	83
1898	92	99	97	92
1899	117	112	105	96
1900	120	121	111	105
1901	113	113	112	114
1902	119	123	128	120
1903	124	137	117	116
1904	115	142	113	124
1905	123	149	121	116
1906	135	163	128	116
1907	137	169	135	125
1908	118	151	126	124
1909	121	164	144	130
1910	120	181	152	134
1911	120	172	131	151
1912	132	168	146	158
1913	136	169	150	135
Averages, 1890–1899	100	100	100	100
1900–1909	123	143	124	119
1910–1913	127	173	145	145
Number of points by which prices rose (+) or fell (−) in —				
1890–1896	−27	−13	−24	−43
1896–1907	+45	+75	+53	+49
1907–1908	−19	−18	−9	−1
1908–1913	+18	+18	+24	+11
Difference between highest and lowest relative prices	50	87	70	82
Average change from year to year	7.0	7.4	8.9	8.2

prosperity, crisis, and depression than any of the other groups. And the anomalies that do appear — the slight rise in three years (1896, 1903, and 1913) when the tide of business was receding — would be removed if the figures were compiled by months. For the trend of mineral prices was downward in these years, but the fall was not so rapid as the rise had been in the preceding years, so that the annual averages were left somewhat higher than before. An index number composed largely of quotations for annual crops, then, would be expected at irregular intervals to contradict capriciously the evidence of index numbers in which most of the articles were mineral, forest, or even animal products.

Fourth, there are characteristic differences between the price fluctuations of manufactured commodities bought by consumers for family use and the price fluctuations of manufactured commodities bought by business men for industrial or commercial use. Such at least is the story told by Table VI. The data employed here are quotations for 28 articles from the Bureau of Labor Statistics' list that rank distinctly as consumers' goods and 28 that rank as producers' goods. Though consisting more largely of the erratically fluctuating farm products, the consumers' goods are steadier in price than the producers' goods, because the demand for them is less influenced by changes in business conditions.

Other groups of related prices having specific peculiarities of fluctuation doubtless exist, but the analysis has been carried far enough for the present purpose. That purpose is to show how the existence of groups of prices which fluctuate in harmony with each other and at variance with other groups affects index numbers in general and in particular the six index numbers for the United States given in Table III. To apply the knowledge gained from the preceding analysis to the explanation of the differences among these six index numbers is not difficult when once the commodities included in each index number have been classified on the basis of the groups which have been examined.

First, the list of commodities used by the Bureau of Labor Statistics includes 29 quotations for iron and its products, 30 quota-

TABLE VI. INDEX NUMBERS MADE FROM PRICES OF CONSUMERS' GOODS AND PRODUCERS' GOODS, BY YEARS, 1890 TO 1913.

[Data from Bulletin of the Bureau of Labor Statistics, No. 149]

(Arithmetic means. Average prices in 1890–1899 = 100)

Year	Consumers' goods	Producers' goods
1890	112	115
1891	109	111
1892	104	107
1893	108	102
1894	100	92
1895	95	91
1896	91	93
1897	90	89
1898	94	93
1899	98	107
1900	106	117
1901	105	113
1902	108	114
1903	105	114
1904	103	114
1905	106	117
1906	110	124
1907	114	133
1908	112	119
1909	114	118
1910	118	126
1911	119	125
1912	118	125
1913	121	123
Averages, 1890–1899	100	100
1900–1909	108	118
1910–1913	119	125
Number of points by which prices rose (+) or fell (−) in —		
1890–1897	−22	−26
1897–1907	+24	+44
1907–1908	− 2	−14
1908–1913	+ 9	+ 4
Difference between highest and lowest relative prices	31	44
Average change from year to year	3.4	4.7

tions for cotton and its products, and 18 for wool and its products, besides 8 more quotations for fabrics made of wool and cotton together. On the other hand it has but 7 series for wheat and its products, 8 for coal and its products, 3 for copper and its products, etc. The iron, cotton, and wool groups together make up 85 series out of 242, or 35 per cent of the whole number. The same three groups furnish 36 (or 25 per cent) of the 145 series in the second index number in Table III. Similarly, cotton, wool, and wheat, or coal, or cattle, with their products, make 20 per cent of the series in the third index number.

Does this large representation of three staples distort these index numbers — particularly the bureau's series where the disproportion is greatest? Perhaps; but if so the distortion does not arise chiefly from the undue influence assigned to the price fluctuations of raw cotton, raw wool, and pig iron. For, contrary to the prevailing impression, the similarity between the price fluctuations of finished products and their raw materials is less than the similarity between the price fluctuations of finished products made from different materials. Such at least is the testimony of Table IV. As babies from different families are more like one another than they are like their respective parents, so here the relative prices of cotton textiles, woolen textiles, steel tools, bread, and shoes differ far less among themselves than they differ severally from the relative prices of raw cotton, raw wool, pig iron, wheat, and hides. Hence the inclusion of a large number of articles made from iron, cotton, and wool affects an index number mainly by increasing the representation allotted to manufactured goods. What materials those manufactured goods are made from makes less difference in the index number than the fact that they are manufactured. To replace iron, cotton, and woolen products by copper, linen, and rubber products would change the results somewhat, but a much greater change would come from replacing the manufactured forms of iron, cotton, and wool by new varieties of their raw forms.

Two practical conclusions of moment to both the makers and the users of index numbers are established by this section. (1) To make an index number that measures the changes in wholesale

prices at large, samples must be drawn from all the various groups that behave in peculiar ways. (2) In using an index number made by others, one must study the list of commodities included critically with these groups in mind to know what it really does measure.

The first conclusion seems to contradict a rule often practiced and sometimes preached. Most of the middle-sized index numbers are confined to raw materials and slightly manufactured goods. Most of the small index numbers are confined to foods alone. The makers of both sets argue that their series are more "sensitive" and therefore better measures of price changes than the larger series, which are loaded down with a mass of miscellaneous manufactured goods. And many users of index numbers seem to prefer a series like Sauerbeck's with only 45 commodities, or even one like the Annalist's with only 25 commodities, to one like that of the Bureau of Labor Statistics with five or ten times the number.

Critics who take this stand usually assume tacitly that the purpose of an index number is to serve as a "business barometer," or to measure changes in "the cost of living." If these aims were always clearly realized by the critics and clearly stated for their readers the room left for differences of opinion would be narrow. In Table III the index number with 145 commodities shows itself a more sensitive and on the whole more faithful barometer of changing business conditions during the 24-year period from 1890 to 1913 than the official series with 242 commodities,[1] and the preceding analysis shows that the sluggishness of the larger index number is due chiefly to its proportion of manufactured goods. For this particular purpose, then, a series modeled after Sauerbeck's has strong claims to preference over one including a larger number of commodities. Indeed, in the light of the preceding discussion one might carry the process of exclusion much further and throw out of the business barometer not only manufactured goods but also all farm crops, on the ground that their prices depend on the eccentricities of the weather, and most forest products, on the ground that their prices are rising so fast as to

[1] Compare page 97.

obscure the effects of bad times, etc. But clearly such exclusions, while they might make the resulting figures more responsive to changes in business conditions, would also make the figures less acceptable as a measure of changes in prices as a whole. The sluggish movements of manufactured goods and of consumers' commodities in particular, the capricious jumping of farm products, the rapidly increasing dearness of lumber, etc., are all part and parcel of the fluctuations which the price level is actually undergoing. Consequently, an index number which pretends to measure changes in the general level of prices cannot logically reject authentic quotations from any of these groups. Every restriction in the scope of the data implies a limitation in the significance of the results.

Probably the most illuminating way of presenting an index number that aspires to cover the whole field of prices at wholesale would be to publish separate results for the groups that have characteristic differences of price fluctuations, and then to publish also a grand total including all the groups. The groups to be recognized and the distribution of commodities among them is a difficult matter to decide. Doubtless intensive research along the lines here followed would suggest the desirability of further subdivisions and perhaps the re-alignment of the whole classification. But, as matters stand, the most significant arrangement seems to be (1) a division of all commodities into raw and manufactured products; (2) the subdivision of raw commodities into farm crops and animal, forest, and mineral products; (3) the subdivision of manufactured products according as they are bought mainly for personal consumption, mainly for business use, or largely for both purposes. It would also be interesting in a supplementary table to bring together index numbers for the leading raw materials and the products manufactured from them.

This classification is based upon differences among the factors affecting the supply of and the demand for commodities that belong to the several groups — that is, upon differences among the factors which determine prices. If we wish our index numbers to help toward an understanding of changes in the price level, a classification along these causal lines promises the most illumi-

nating results; but it is not the basis of classification usually adopted.

In most large index numbers the commodities are divided among several classes, but these classifications seldom possess logical consistency. Among the nine groups recognized by the Bureau of Labor Statistics, for example, one group, "Farm products," emphasizes the place of production; four groups, " Food, etc.," " Fuel and lighting," " Lumber and building materials," and " House-furnishing goods," emphasize the use to which commodities are put; three groups apply a double criterion, use and physical character of the goods, namely, " Cloths and clothing " (which includes such articles as 2-bushel bags), " Metals and implements," and " Drugs and chemicals "; the remaining group is frankly styled " Miscellaneous." Such a classification is not without usefulness, for there doubtless are readers especially interested in the prices of, say, all things that are raised on farms, and others who care especially about the prices of things used to furnish houses, or things that can be classed together as drugs and chemicals whether they are used chiefly as medicines or to make farm fertilizers. But if a classification of this empirical character is maintained, it might with advantage be accompanied by a classification that throws more light upon the workings of the complex system of prices.

As for the small series made from the prices of foods alone or from the prices of any single group of commodities, it is clear that, however good for special uses they may be, they are untrustworthy as general-purpose index numbers.

A food index number, then, is likely at any time to give a wrong impression regarding the shifting of prices in general and is especially treacherous as a business barometer. Nor can such an index when made from wholesale prices be trusted to show changes in the " cost of living "; for living expenses are made up of retail prices, and fluctuations in retail prices do not follow closely those in the wholesale markets.

The second conclusion which this section establishes is that large index numbers are more trustworthy for general purposes than small ones, not only in so far as they include more groups of

related prices, but also in so far as they contain more numerous samples from each group. What is characteristic in the behavior of the prices of farm crops, of mineral products, of manufactured wares, of consumers' goods, etc. — what is characteristic in the behavior of any group of prices — is more likely to be brought out and to exercise its due effects upon the final results when the group is represented by 10 or 20 sets of quotations than when it is represented by only one or two sets. The basis of this contention is simple: In every group that has been studied there are certain commodities whose prices seldom behave in the typical way, and no commodities whose prices can be trusted always to behave typically. Consequently, no care to include commodities belonging to all the important groups can guarantee accurate results, unless care is also taken to get numerous representatives of each group.

Even here the matter does not end. The different groups that have been discussed, the other groups that might have been discussed, and the commodities that are included within the several groups differ widely in importance as elements in the system of prices. To these differences, and to the methods of making them count in index numbers, we must now turn.

Problems of Weighting

It is customary to distinguish sharply between " simple " and " weighted " index numbers. When an effort is made to ascertain the relative importance of the various commodities included, and to apply some plan by which each commodity shall exercise an influence upon the final results proportionate to its relative importance, the index number is said to be weighted. When, on the contrary, no such effort is made, but every commodity is taken just as it comes and supposedly allowed just the same chance to influence the result as every other commodity, the index number is said to be unweighted, or simple.

In unweighted series, however, it is seldom true that every commodity has just the same chance to influence the result as every other commodity. For example, in Bradstreet's index the influence of every article upon the result varies as its price per

pound happens to be large or small. Again, the decisive objection to making index numbers by merely adding the ordinary commercial quotations for different articles is that these nominally simple series are in fact viciously weighted series. Nor does the substitution of relative prices for actual prices assure an equal chance to every article. For instance, in its famous report of 1893, the Senate Committee on Finance presented three wholesale-price index numbers — one simple and two weighted; but in the simple series it included relative prices for 25 different kinds of pocket-knives, giving this trifling article an influence upon the result more than eight times greater than that given to wheat, corn, and coal put together. Finally, even if one series of relative prices, and only one, be accorded each commodity, it does not follow that equal percentages of change in the price of every article will always exercise equal influence upon the results. For, as shown above, when the relative prices are computed upon a fixed base and averaged by the use of arithmetic means, those commodities that have a long period upward trend in price will presently far outweigh in influence those commodities whose prices are declining.

Lack of attention to weighting, then, does not automatically secure a fair field and no favor to every commodity; on the contrary, it results in what Walsh happily termed haphazard weighting.[1] Indeed, when it is desired to give each commodity an equal chance to influence the results, great care must be taken; practically a scheme of equal weights must be devised. The real problem for the maker of index numbers is whether he shall leave weighting to chance or seek to rationalize it.

There are two excuses for neglect of weighting. First, as has been shown in another connection, to collect satisfactory statistics showing the relative importance of different commodities is

[1] C. M. Walsh, *The Measurement of General Exchange-Value*, pp. 81 and 82. Haphazard weighting is not necessarily the worst weighting; indeed, it often is better than the weighting which results from some systematic calculations. For example, Bradstreet's plan of using actual prices per pound is certainly systematic, but the weighting which this system involves is probably less defensible than the haphazard weighting involved in most averages of the relative prices of commodities selected at random. See p. 95.

extremely laborious and extremely difficult. Second, there are high authorities who hold that the results turn out much the same whether or not formal weights are used.[1] Certainly "the weights are of much less importance in determining an index number to prices than the prices themselves."[2] But whether their importance is negligible is a question best answered by a study of actual cases.[3]

The discrepancies here revealed between the averages with haphazard and with systematic weights seldom amount to 10 per cent of the results, except under the chaotic price conditions created by the greenback standard in 1862–1873. In many kinds of statistics a 10 per cent margin of error is not accounted large. But in making wholesale-price index numbers for current years we may reasonably try to get not two, but three, significant figures; and the third figure is usually altered in appreciable degree by the substitution of systematic for haphazard weights. Even the large Canadian series, with its 272 commodities, is shifted 9.5 points, or more than 7 per cent, in 1912 by weighting.

If rational weighting is worth striving after, then, by what criterion shall the relative importance of the different commodities be judged? That depends upon the object of the investigation. If, for example, the aim be to measure changes in the cost of living, and the data be retail quotations of consumers' commodities, then the proportionate expenditures upon the different articles as represented by collections of family budgets make appropriate weights. If the aim be to study changes in the money incomes of farmers, then the data should be "farm prices," the list of commodities should be limited to farm products, and the weights should be proportionate to the monetary receipts from the several products. If the aim be to construct a business barometer, the data should be prices from the most representative wholesale markets, the list should be confined to commodities whose prices are most sensitive to changes in business prospects

[1] Compare A. L. Bowley, *Elements of Statistics*, 2d ed., pp. 113 and 220–224.

[2] Irving Fisher, *The Purchasing Power of Money*, revised edition, p. 406. For further details see the papers by Edgeworth to which Fisher refers in his footnote.

[3] An illustrative table is given on pp. 74–75, *Bulletin of the United States Bureau of Labor Statistics*, No. 173. [Editor.]

and least liable to change from other causes, and the weights may logically be adjusted to the relative importance of the commodities as objects of investment. If the aim be merely to find the differences of price fluctuation characteristic of dissimilar groups of commodities, or to study the influence of gold production or the issue of irredeemable paper money upon the way in which prices change, it may be appropriate to give identical weights to all the commodities. If, on the other hand, the aim be to make a general-purpose index number of wholesale prices, the question is less easy to answer.

One proposition, however, is clear. The prevalent practice of weighting wholesale-price index numbers by figures drawn from family budgets is to be deprecated. For family budgets do not show the importance of wheat and cotton, of petroleum and spelter, of tar and lime, of pig iron and hides, of brick and lumber; indeed, to apply budget weights to half or more of the articles in any wholesale list is impossible, or at best nonsensical. And to pretend that wholesale-price index numbers when weighted on the basis of family expenditures show fluctuations in the cost of living is to overtax the credulity of those who know and to abuse the confidence of those who do not.

Allied to the family-budget method of weighting and yet vastly better for wholesale-price index numbers is the "aggregate expenditure" method. Here an attempt is made to ascertain the aggregate sums of money laid out by the people of a whole country upon the articles quoted and to adjust their weights upon this basis. Of course the country as a whole buys raw materials, as single families do not, and of course consumers' commodities can be taken at their aggregate values in wholesale markets. Similar in net effect is the weighting on the basis of consumption practiced by the British Board of Trade. For "consumption is taken to mean any process by which the commodity is substantially changed in character. In other words, consumption in manufacture is recognized as well as consumption by an individual."[1] Somewhat different weights would result if quantities

[1] *Report on Wholesale and Retail Prices in the United Kingdom in 1902.* London, 1903, p. 441. The accuracy of the statistics upon which the Australian and

or values produced were taken in place of quantities or values consumed. Mr. Walsh thinks it best to combine these two criteria — that is, to take "either the total product or the total consumption according as the one or the other is the greater."[1] Professor Irving Fisher prefers "an index number in which every article or service is weighted according to the value of it exchanged at base prices in the year whose level of prices it is desired to find."[2] On this system the weight assigned to each article would be affected by the number of times it changed hands on its way from producer to final consumer. A variation of his plan is therefore represented by the proposal to weight each article according to the quantity of it which enters into the country's commerce, irrespective of the frequency with which it changes hands.

The practical consequences of adopting these different systems of weighting may be illustrated by considering their application to cotton, corn, and coffee in the United States. Production weights would give cotton much greater importance than consumption or aggregate-expenditure weights, because so large a part of the American crop is exported and consumed abroad. Exchange weights would be practically equivalent to production weights, because practically all the cotton grown is sold by the planters and enters into the commerce of the country, and very little cotton is imported. On Professor Fisher's plan, however, the exchange weights would be some multiple of the production weights, depending upon the average number of American hands through which the cotton passed. In the case of corn, production and consumption weights would substantially agree, for we import very little corn and export but a very small percentage of the production. On the other hand, exchange weights would be much less than either production or consumption weights, because a large part of the corn crop is never sold, but is consumed on the farms where it is grown. In the case of coffee, production weights

British index numbers are based may be open to question. Not the data, but the method is of interest here.

[1] C. M. Walsh, *The Measurement of General Exchange-Value.* New York, 1901, p. 95.

[2] Irving Fisher, *The Purchasing Power of Money*, revised edition. New York, 1913, pp. 217 and 218.

would be practically zero, while consumption and exchange weights would correspond closely.

We are helped toward a choice among these rivals by common agreement upon a slightly different point. In arranging any system of weights except Professor Fisher's, double counting is to be avoided so far as possible. For example, if cotton is counted at its full importance as a raw material, then cotton yarns and later cotton fabrics made of the yarn cannot be counted at their full importance without assigning triple weight to the raw cotton which is represented at these two successive stages of manufacture. Now, if this sensible observation be applied to cases like those of corn, hay, etc., it casts the die in favor of exchange weights. For if these articles, which are used largely by the original producers in making things quite different from corn and hay (for instance, pork and beef), are counted at the full amount produced or consumed, and if their products (the pork and beef) are also counted at the full amount produced or consumed, there will be a great deal of double counting. Not all but much of this duplication can be eliminated by counting only the amount of corn and hay sold by the producers and letting the rest of these articles produced and consumed get their proper representation under the captions of pork, beef, etc.

If for this reason exchange appears a rather better criterion of importance than production, consumption, or a combination of the two, it remains only to decide whether the number of times a thing is exchanged should be recognized. Professor Irving Fisher had good cause to propose multiple counting, for he wanted an index number of prices for constructing the "equation of exchange," a mathematical expression of the necessary equivalence between the total volume of business done in a country and the total volume of payments effected by means of money and credit instruments. Of course the oftener an article is sold and paid for the more important it is as a factor in this equation. But it does not follow that the economic importance of an article is greatly changed by reorganizing the chain of business enterprises that deal in it. "Integration of industry," as expressed in our trusts, does not make pig iron less significant as an item in the country's

economic life, except in the sense that it reduces the average number of transfers of ownership. The quantity of the article that enters into exchange, then, irrespective of the number of turnovers, is probably the most satisfactory gauge of importance to apply in making general-purpose index numbers. But anyone experienced in the search for statistical information will need no warning that in the working out of weights along this line many puzzling cases will arise in which consistency will be difficult to maintain, to say nothing of wide gaps and many weak places in the existing data being revealed.

Critical Valuation

A just evaluation of our seven American index numbers is not easy to make. For a comparison has little meaning unless it deals with all the important points at which the series differ. And since no one series is superior to the others at all points a verdict cannot be rendered in a single sentence.

In the publication of actual prices, the Bureau of Labor Statistics and Bradstreet's stand foremost. The contribution they have thus made to the knowledge of prices possesses great and permanent value over and above the value attaching to their index numbers. For, it is well to repeat, all efforts to improve index numbers, all investigations into the causes and consequences of price fluctuations, and all possibility of making our pecuniary institutions better instruments of public welfare depend for their realization in large measure upon the possession of systematic and long-sustained records of actual prices. And much of this invaluable material would be lost if it were not recorded month by month and year by year.

Critical users of statistics justly feel greater confidence in figures which they can test than in figures which they must accept upon faith. Hence the compilers of index numbers who do not publish their original quotations inevitably compromise somewhat the reputation of their series. They compromise this reputation still further when they fail to explain in full just what commodities they include, and just what methods of compilation they adopt.[1] In the latter respect the Annalist index number

[1] Compare p. 57.

shares first honors with the Bureau of Labor Statistics' series. Anyone who chooses to take the trouble can find what commodities are used, and how the final results are worked up from the raw material. Bradstreet's index number suffers a bit in comparison because readers are not told which 96 commodities out of the 106 of which prices are published are included in the index number, and because the method of reducing prices by the yard, the dozen, the bushel, the gallon, etc., to prices per pound is not fully explained. Dun's index number is more mysterious still, because neither the list of commodities nor the weights applied to each commodity are disclosed. And Gibson's present series also stands partly in the shadow because, while the list of commodities is known, the publishers state merely that these articles are weighted by Dun's system.

With reference to weighting, Bradstreet's index number takes low rank, for the plan of reducing all quotations to prices per pound grossly misrepresents the relative importance of many articles. That figures made thus should give results in close agreement with the Bureau of Labor Statistics' series is a remarkable demonstration of the ability of index numbers to extract substantial truth even from unpromising materials. The agreement is all the more remarkable since the bureau's series is also badly weighted, though in a different way and in less degree. The revised bureau series is scarcely better than the original in this respect. It is better in substituting a single set of relatives for the articles of minor importance to which the original accorded several sets (for example, shirtings, sheetings, tools, window glass, etc.), but worse in cutting down the representation accorded to great staples (for example, pork, coal, pig iron, and leather). The Annalist index number follows the sensible, though rudimentary, plan of including two or three varieties of the most important articles, and only one of the less important. The like can be said in favor of Gibson's index number, both in its original and its present form, and in addition Gibson uses the Dun system of weights. The latter system is, in theory, the nearest approach to a satisfactory plan of weighting made by any American index number at present. Whether the practice is as good as

the theory is doubtful, to say the least, for anyone familiar with the deficiencies of American statistics of consumption must wonder whence the compilers derived their estimates of the quantities of 310 commodities "annually consumed by each inhabitant." Moreover, what little is known concerning the actual weights is not unobjectionable. Fifty per cent of the total is too large a weight to allow to foods in a wholesale-price series. Even in the great collection of budgets of workingmen's families made by the Commissioner of Labor in 1901 the average expenditure for food was less than 45 per cent of total family expenditure;[1] and in wholesale markets, of course, many commodities that are never directly consumed by families have great importance.

Dun's index number is supposed to stand first in number of commodities included, but lack of definite information makes it impossible to judge whether its list is well balanced. The bureau's list also is long and contains samples of many different kinds of goods, manufactured as well as raw, consumed for all sorts of purposes and produced under all sorts of conditions; but the representation accorded to different parts of the whole system of prices is certainly far from equitable. Bradstreet's list, while less than half as long as the bureau's, seems better chosen. It is particularly strong in raw materials and rather weak in manufactured goods. The same remarks apply to Gibson's original list, though it suffers in comparison by being about half the length of Bradstreet's. Finally, the present Gibson index number and the Annalist series are confined to foodstuffs, and make no pretense of representing prices at large.

In the form of presenting results, Bradstreet's set an admirable example, which was wisely followed by Dun's. Their sums of actual prices can readily be turned into relatives on any base desired, and hence can be made to yield direct comparisons between any two dates. The other series, as averages of relative prices on the 1890–1899 basis, cannot be properly shifted without a detailed recomputation of the relative prices of each commodity,

[1] *Eighteenth Annual Report of the Commissioner of Labor*, 1903, p. 66. The data represented 25,400 families and 124,108 persons, both natives and immigrants.

and force readers to make all their comparisons in terms of what prices were in the decade used as base.

It is interesting, finally, to test the reliability of the several index numbers as "business barometers." Monthly figures would be much better than our yearly averages for this purpose; but, since they are not to be had for most of the series during most of the period covered, we must do the best we can with the rougher gauge. In 11 of the 23 cases of changes from one year to the next the seven index numbers disagree as to whether prices rose, fell, or remained constant. In the following schedule these 11 years are represented by columns in which each index number is credited with plus one when its change accords with the character of the alteration in business conditions, debited with minus one in cases of disagreement, and marked zero when it recognizes no change in the price level.[1] The net scores made by casting up the plus and minus entries indicate roughly the relative faithfulness with which these series have reflected changes in business conditions in the past. Of the index numbers regularly published, Bradstreet's makes much the best showing. Even the scores against it in 1895 and 1903, and its failure to show the reaction in business conditions in 1913, would be wiped out were the data by quarters and months used in place of the annual averages.

Index number	1891	1893	1895	1897	1901	1903	1904	1905	1908	1910	1913	Net score
1. Bradstreet's.......	*+1	+1	−1	+1	+1	−1	+1	+1	+1	+1	...	+6
2. Bureau of Labor Statistics, revised	+1	+1	−1	...	+1	...	...	+1	+1	+1	+1	+6
3. Gibson, original....	...	...	...	+1	+1	+1	−1	+1	+1	+1	...	+5
4. Bureau of Labor Statistics, original	+1	...	−1	...	+1	−1	+1	+1	+1	+1	...	+4
5. Annalist..........	−1	−1	−1	+1	−1	+1	−1	+1	−1	+1	+1	−1
6. Dun's............	−1	−1	−1	−1	−1	+1	−1	...	+1	+1	+1	−2
7. Gibson, present....	−1	−1	−1	+1	−1	+1	+1	−1	−1	...	+1	−2

* Based on Bradstreet's original figures for 1890 and 1891, figures which are not used in the index number as currently published.

[1] For a description of American business conditions in this period, see W. C. Mitchell, *Business Cycles*, Chapter III (Summary, p. 88).

CHAPTER II

STATISTICAL INDICES OF BUSINESS CONDITIONS

I. Statistical Indices of Business Conditions [1]

By Melvin T. Copeland

It is the purpose of this article to discuss the use of statistics for indicating the trend of business conditions. The first task is to ascertain what available statistics are symptomatic of business changes; the second to examine critically some of the methods by which statistics are being used at the present time for business forecasting; and the third to suggest an improved method. The subject is large and the work is still in an experimental stage; hence all conclusions must be considered tentative.

This subject obviously is not merely academic, but of large practical interest. Bankers, financiers, and the heads of manufacturing and mercantile enterprises must constantly study present conditions and future prospects. Many manufacturers, for example, buy raw materials and start manufacturing operations months before the finished goods are placed upon the market. Plans must be made and production regulated according to the conditions which such producers expect to encounter at a later time. If they err in judgment, they are placed at a disadvantage which may prove serious. The maladjustment which occurs during a period of crisis may be disastrous. If manufacturers and merchants can be forewarned, fewer will be caught unawares and the severity of the shocks will be alleviated.

It is now generally agreed by students of the subject that the ups and downs of business prosperity are due to deep-seated influences, and business men are more and more giving up the long persisting notion that changes in business conditions are caused primarily by tariff acts, political happenings, or court decisions.

[1] *Quarterly Journal of Economics*, vol. 29, pp. 522–562. Reprinted by permission of the *Quarterly Journal of Economics*.

More attention is being given to the symptomatic statistics currently published in the financial journals, trade publications, and daily papers. Some executives have statistical reports carefully prepared for their own businesses in order to make comparisons with previous periods and with the external statistics for other industries and trades.

The published statistics, although inadequate for a complete analysis, furnish ample material for experimentation. Each set of statistics, however, requires careful examination; some are worthless. Moreover, of those statistics which appear to be reliable barometers of business changes, only those which are available daily, weekly, or monthly can ordinarily be used. A business man wishes current information; for him statistics which are a year old are more or less antiquated. And in studying long time fluctuations and the large trade cycles, annual figures are unsatisfactory because of the impossibility of determining to what extent the figures represent the antecedents and to what extent they represent the effects of important events happening within the calendar or fiscal year. The annual statistics for the years 1873, 1893, and 1907, for instance, are not properly comparable in a study of crises, since the panic of 1873 began in the middle of September, that of 1893 in May, and that of 1907 in October. In the annual figures for these years the antecedents and the effects of the panics are thrown together in unequal proportions. In most instances a monthly basis of comparison seems to give the best results. With these considerations in mind we can proceed to an examination of the statistics.

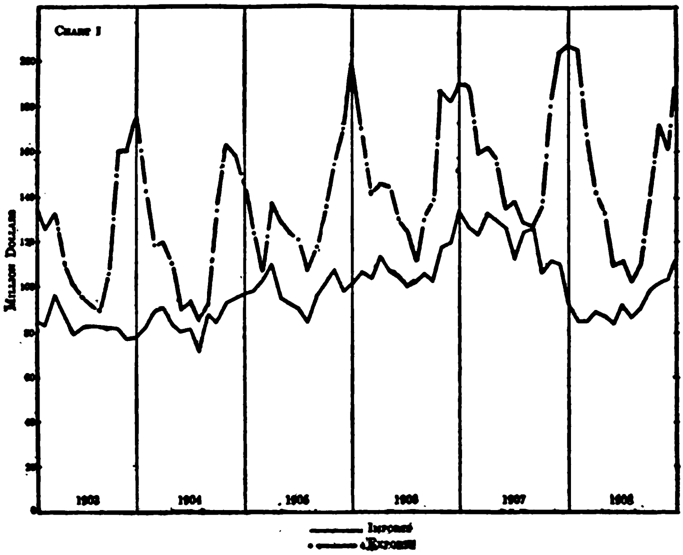
Available Statistics

(1) *Imports of Merchandise.* The statistics for the value of merchandise imported into the United States correlate with business conditions.[1] During periods of prosperity more raw materials are bought for our manufacturing plants and the imports of finished goods for immediate consumption are also larger. During periods of depression, on the other hand, our purchases

[1] Import and export statistics are published in the *Monthly Summary of Commerce and Finance* and in various financial journals.

in foreign markets fall off. Although the import statistics are affected by general changes in price level, short time comparisons can safely be made. Their most serious defect is in their susceptibility to the influence of tariff changes; but this does not destroy their worth as an index to general conditions.

In order to show the course of imports during a portion of a typical business cycle, the monthly statistics for the years 1903–08 have been plotted on Chart I. Final conclusions cannot, of



course, be drawn from statistics for so short a period, but for experimental purposes these years seem to be representative. The general upward trend of the curve during the years of prosperity immediately preceding the crisis of 1907 is noteworthy. The effects of the crisis are shown in the ensuing decline. It is to be noted, also, that these statistics show a seasonal fluctuation, with a peak in March, due presumably to the importing of merchandise for the spring trade, a sag in the summer, and another upward movement in the autumn caused by imports of merchandise for the holiday trade.

(2) *Exports of Merchandise.* For judging business conditions, the export statistics of the United States are much less useful

than the import statistics.[1] The export statistics are, in themselves, less reliable because of the greater percentage of error in the returns; they are not scrutinized by the customs inspectors and there is no adequate check upon the accuracy of the exporters' manifests. Furthermore, because of the predominance of raw materials and foodstuffs in our export trade, the volume of our exports depends largely upon conditions affecting demand from foreign countries. The movement does not necessarily indicate the strength or weakness of the domestic situation. The exports of manufactured goods tend to fall off with improvement in domestic demand and to increase during depression, when our manufacturers show their greatest interest in developing foreign trade. The course of the export trade, 1903–08, is also shown on Chart I. The marked seasonal fluctuation is due to the heavy exportation of raw cotton and other agricultural products during the late autumn and winter months.

Balance of trade statistics, which show the difference between imports and exports, seem to me to have little significance. There are so many invisible exports and imports that the balance of trade figures always involve a large element of uncertainty. How great is the foreign indebtedness upon which interest payments are due? Is the investment of foreign capital increasing or is the foreign indebtedness being paid off? What shipments of securities are being made? What transportation charges are to be paid? No record can be kept of all these transactions, which have just as much influence as the visible merchandise shipments upon foreign exchange rates and the movement of specie.

(3) *Immigration.* The statistics for immigration fluctuate in a general way with business conditions in the United States. An upward tendency was indicated, for example, during 1905, 1906, and 1907, and a marked reaction in 1908. The immigration figures are of especial interest to certain manufacturers, since they give some indication of the increase in the supply of unskilled labor. Their significance as a general index, however, is lessened

[1] The export statistics for Great Britain, on the contrary, are a particularly good index of conditions in that country, since the British manufacturers are so largely dependent upon foreign markets.

by the fact that the movement of immigrants adjusts itself only with more or less delay, according to information transmitted from this country to the foreigners before they leave their homes. The net immigration, that is the total number of immigrants less the number of emigrants, should be more significant; but the latter figures have been published only since July, 1907. A much more serious criticism of the use of immigration statistics as a business barometer is that they are influenced not only by conditions in the United States but by industrial, social, and political conditions in the countries whence the immigrants come. At best these statistics could not show a very close approximation to actual changes in business conditions in this country. At the present time, in consequence of the European war, all comparisons have become inconclusive.[1]

(4) *Bank Clearings.* Because of the wide-spread custom of making payments by check, bank clearings give a fairly accurate index to the volume of business transactions. Although influenced by general changes in prices, by bank consolidations, and by the spread of the check-using habit, bank clearings show approximately how much business is being done at any one time. As a business index, the bank clearings for the United States exclusive of New York City are more significant than the total clearings. The New York clearings, which constitute about one-half of the total clearings for the country, are so affected by the volume of speculative transactions upon the Stock Exchange that they should at least be considered separately. The clearings in other cities where stock exchanges are located are not a sufficiently large proportion of the total to necessitate their exclusion. Bank clearings are not subject to wide fluctuations and do not indicate what is likely to take place in the future, but they do show in a general way what is taking place. The clearings statistics as reported by *Bradstreet's*, the *Commercial and Financial Chronicle*, and *Dun's Review* differ slightly in detail but approximately agree.

(5) *Railroad Gross Earnings.* Railroad traffic fluctuates with the amount of business being done in the community. As an in-

[1] Immigration statistics are currently published in numerous periodicals and also in the *Monthly Summary of Commerce and Finance.*

dex to the volume of traffic, since tonnage figures are not currently available,[1] railroad gross earnings are commonly used. Statistics for net earnings show the general financial condition of the roads, but are far less useful for general purposes than the gross earnings. The latter are in the same class as bank clearings, showing what is taking place but foretelling little of the future.

Because of the delay which occurs in securing reports from some of the companies, the total earnings for all the roads in the country cannot advantageously be used in studying business indices. It is necessary, therefore, to take the earnings for a representative group of roads. In the *Commercial and Financial Chronicle* statistics for the earnings of a group of roads are given monthly. These statistics are usually made up from preliminary returns and are thus, to some degree, subject to revision. The most serious difficulty, however, which prevents the use, except for casual observations, of such compilations as those of the *Commercial and Financial Chronicle*, is that the make-up of the group continually changes. The number of roads included varies from month to month, yielding totals which usually can be compared only with the preceding month or with the corresponding month of the preceding year. Mr. Babson presents on his desk sheet a useful monthly table of the total gross earnings of ten railroads, always including figures for the same roads.

(6) *Idle Cars.* From January, 1908, to November, 1914, the American Railway Association issued semi-monthly reports on the number of idle freight cars. Since February 1, 1915, monthly reports have been issued. Although these reports have probably been of assistance to railroad officials by furnishing a guide to traffic demands and by enabling them to secure a better balance of car supply, I am disposed to think that the statistics are much less reliable as a business index than has been commonly believed.

In the first place, the number of roads reporting has varied. On April 1, 1914, the number of roads reporting was 190; on June 1, 176; on October 1, 204; and on November 1, 192. Similar

[1] For a few years the American Railway Association has published a monthly bulletin, *Statement of Freight Car Balance and Performance*, which gives, amongst other things, the ton-miles of freight carried, but these bulletins appear several months late.

variations appear for other months. Further, in making any long time comparisons, the change in the capacity of the cars is also to be considered. But neither of these factors is so fundamental as the irregularity in the number of new cars added from year to year. The statistics for the number of freight cars idle cannot show the fluctuation in the volume of traffic and, hence, the amount of business done, when the number of cars available for service itself fluctuates irregularly. The number of idle cars depends not only upon the number actually in use, but also upon the number of new cars added and of old cars scrapped. The variations in the number of cars in service are shown by the following table, compiled from the bulletins of the American Railway Association. The wide divergencies in the number of new cars added during these years vitally affect the number of cars idle at any one time; hence, without a statement each month of

Revenue Freight Cars

	Cars Owned at End of Year	Increase or Decrease During Year	Average Number Idle Per Month	Largest Number Idle	Smallest Number Idle
1908	2,077,764	+ 78,843	273,600	408,900	104,800
1909	2,049,015	− 28,749	187,800	321,800	− 4,300[1]
1910	2,162,444	+ 113,429	59,300	138,100	10,900
1911	2,197,399	+ 34,955	124,100	198,500	24,800
1912	2,207,516	+ 10,117	34,100	113,100	− 50,600[1]
1913	2,297,818	+ 90,302	42,200	79,400	2,200

[1] Shortage.

additions or withdrawals, idle car statistics should be used with extreme caution. The statistics as commonly published give us little clue as to the degree of change which has taken place.

(7) *New Building*. Numerous cities now have building regulations and require that a permit be obtained from a building commissioner before construction may be commenced. A record of these permits is kept, furnishing an index to building activity. The figures, to be sure, indicate only the plans at the time that the permit is issued and do not show over how long a period the building operations will extend or what cessations of construction occur. Nevertheless they should serve roughly as a general index.

The financial papers regularly publish compilations of statistics for new building, but not in a form for continuous comparisons. *Bradstreet's*, for example, has a monthly table of new building statistics, but the number of cities included varies from month to month, and occasionally the figures for some of the large cities are omitted, thus introducing a relatively large percentage of error. For this subject Mr. Babson also has a serviceable table on his desk sheet, which gives the value of the new building permits issued in twenty selected cities.

(8) *Commodity Prices.* Prices of commodities tend to rise during periods of prosperity and to fall during periods of depression. The most accessible general index for monthly changes in commodity prices is that published by *Bradstreet's*. The index number is in the form of the "total of the prices per pound of ninety-six articles," including breadstuffs, livestock, provisions, fruits, hides and leather, textiles, coal and coke, metals, oils, naval stores, building materials, chemicals and drugs, and miscellaneous. This method of computation permits such articles as silk cloth, which is light in weight and high in price, to exercise more influence on the totals than is exercised by the bulky staple commodities. And, so far as I know, no explanation has ever been given of the methods of finding the price per pound of eggs or per pound of oil. Ninety-six pounds of such an incongruous mixture is hard to imagine.

(9) *Business Failures.* The frequency of business failures tends to vary inversely with general business conditions. During periods of prosperity bankruptcies diminish. But as soon as depression sets in, the weaker firms, which have been able to hold on because of strong business conditions, fail in greater numbers. The statistics for business failures are a particularly sensitive index and show to what extent liquidation has progressed. They aid in forming a judgment as to when business recovery is to be anticipated.

Statistics for the number and liabilities of business failures are published by both *Dun's Review* and *Bradstreet's*. The figures from these two sources differ somewhat in detail but show the same general tendencies. The statistics for the total liabilities of

failures are more commonly used than the statistics for the number of failures. The liability figures, however, occasionally show a sharp increase in consequence of a single heavy failure which, from the general point of view, does not deserve the weight thus given it. Such experiments as I have made indicate that the statistics of failures by number correlate more closely with other business indices.[1] The statistics of business failures, like so many others, show a marked seasonal fluctuation, reaching their high point during the inventory months of December and January each year.

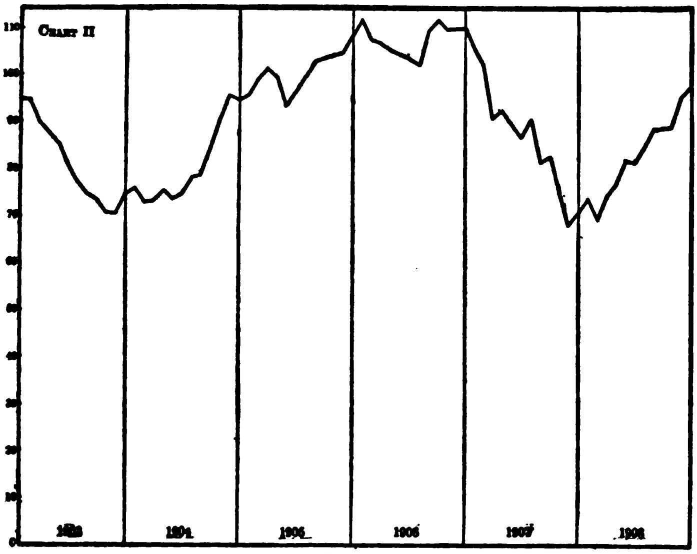
(10) *Stock Market.* Security quotations on the Stock Market fluctuate sensitively with every change and with every rumor of change in business conditions. The prices of securities rise during periods of prosperity owing to general optimism and high dividends. But when money rates begin to tighten, the stock market is one of the first indices to give warning of the coming crisis. Beginning in January, 1907, for instance, there was an almost constant decline until after the panic, as is shown upon Chart II. The curve indicates the changes in the average price of twenty-five stocks on the New York Stock Exchange.

Several stock market barometers, or indices of security prices, are published. I have used that of the *Boston Transcript.* Until the closing of the Stock Exchange in July, 1914, this barometer gave daily the changes in the average price of twenty-five stocks, including eighteen railroads, one public service company, and six industrials. These were, on the whole, well-selected and representative. The stock market index of the *Wall Street Journal* has been more commonly used for showing movements of security prices; but amongst the twelve industrials which it formerly included there was one quotation for United States Steel preferred, one for United States Steel common, one for United States Rubber preferred, and one for United States Rubber common. The weight thus given to steel and especially to rubber seems to have been unwarranted. Recently a quotation for

[1] My tentative conclusion that the number of failures is the better index is supported also by Mr. D. R. Little, editor of *Dun's Review,* who states: "The number of failures reflects conditions more accurately than do the aggregate liabilities." *Moody's Magazine,* February, 1915, p. 79.

General Motors has been substituted for United States Rubber preferred.

The average monthly figures which are plotted on the chart were obtained by taking an average of the Saturday quotations for each month. This average of the Saturday quotations varies



Average Price of 25 Stocks

little from an average of all the days in the month and is fully representative.

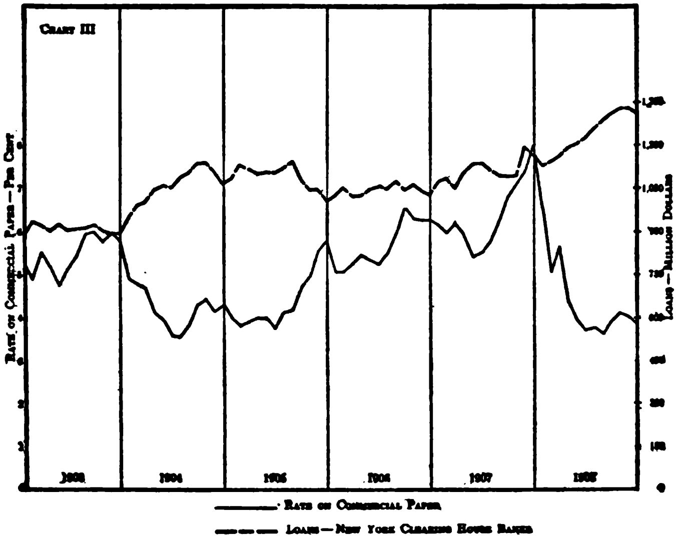
The volume of transactions upon the New York Stock Exchange is also of some value as a business index. Purely speculative influences or manipulation, however, may cause a rise or decline in the activity of the stock market, which does not correlate with actual changes in business prospects.

(11) *Money Rates.* The average rate on 60–90 day commercial paper serves as an index to money rates. The curve for money rates on Chart III has been plotted from the monthly averages given by Professor Mitchell in his *Business Cycles.*[1] This curve correlates closely with changes in business conditions, sagging at times of depression, rising gradually with increasing prosperity,

[1] Current figures for money rates are conveniently published in the *Commercial and Financial Chronicle.*

and then moving sharply upward during a crisis. It is one of our most useful indices.

(12) *Bank Loans.* Banking statistics in general have been so affected by the introduction of the new Federal Reserve system that few comparisons can safely be made with the past. Banking indices in the future can probably be worked out only after a new

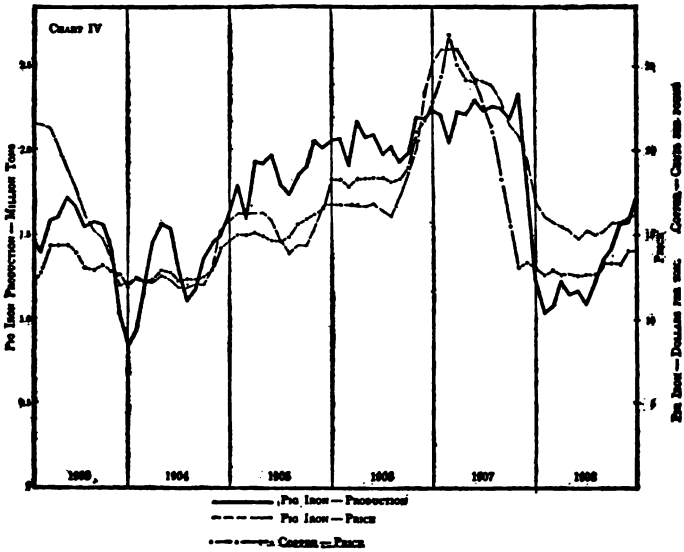


set of statistics has been accumulated. For purposes of illustration, however, the average loans of the New York Clearing House banks may be taken. The course of these loans, as indicated by monthly averages of the weekly figures given in the *Commercial and Financial Chronicle*, is shown for the years 1903–08 on Chart III. It will be seen that the change from month to month is slight. In fact the relative stability of these figures during the period of rising money rates in 1906–07 gives them a peculiar significance, since it shows that the New York banks were regulating their loans with a view of just barely maintaining the required 25 per cent reserve against deposits.[1] When money rates were low, during depression, more funds were deposited in

[1] O. M. W. Sprague, *History of Crises under the National Banking System*, p. 222.

New York by the country banks and loans expanded. The banking system was exceedingly ill-adjusted for meeting an emergency.

(13) *Pig Iron.* The classical business barometer is the iron industry. This industry is sensitive to changes in business conditions because of the fact that iron is used so largely for the construction of new machinery, new railway equipment, and recently



for new building. The demand for iron falls off immediately when business depression begins, since additions and renewals cease. Construction work being postponable, the iron industry is one of the first to feel the effects of forced economy.

As is shown on Chart IV, the price and production of pig iron tend to move together. During periods of prosperity both production and price tend to rise, whereas after a crisis both fall. This same tendency is manifested by numerous other commodities. At times, however, price and production move in opposite directions, as for example, when a considerable addition to the producing capacity has been made. For this reason it seems that both the price and production figures should be taken into account. So far as the years 1903–08 are concerned, attention is to be called to the rapid rise in price in the latter part of 1906

and to the decline which began in April, 1907. The price of pig iron broke in April although the panic did not occur until October. The production kept up until November. The statistics which were used were obtained from the *Iron Age*.[1]

Another index to the conditions of the iron and steel industry is the unfilled orders of the United States Steel Corporation, which were published quarterly till June, 1910, and since then monthly. The freedom with which cancellations are permitted in the steel trade lessens the value of these figures, but they may well be considered in connection with the prices of Bessemer billets or other steel products.

(14) *Copper*. This commodity is in the same class as iron and, since it is used for similar purposes, has become as sensitive a barometer. The greatest demand is, of course, from the electrical industries. Statistics for the monthly production of copper in the United States were published by the Copper Producers' Association from January, 1909, to June, 1914. This period is too short to permit comprehensive comparisons to be made. The statistics for the average price of electrolytic copper, as given by the *Engineering and Mining Journal*, for 1903–08, are plotted on Chart IV. The general movement of the price of copper was similar to that of the price of pig iron, but the former broke in March, 1907, one month earlier than pig iron.

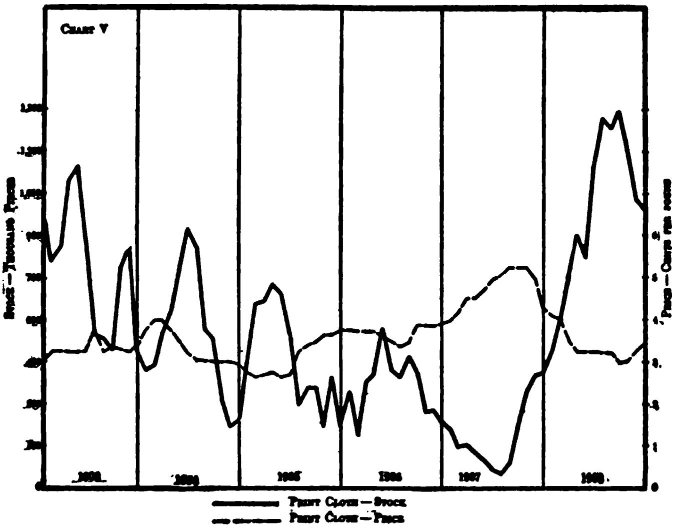
(15) *Print Cloth*. For the textile industries and the dry goods trade few indices are now available. Price quotations and weekly statements of the sales of print cloth in Fall River are published in the *New York Journal of Commerce* and elsewhere. These sales statistics are not strictly accurate and there is no check to show the percentage of error. They should indicate roughly, however, the general condition of the trade in cotton cloth. Under ordinary conditions the sales are in part for future delivery, the deliveries extending over two or three months, and after delivery the cloth must be converted, that is printed. Hence the volume of sales indicates the outlook in the dry goods market.

The price figures represented by the curve on Chart V are the averages of the Monday quotations for 28 inch, 64 x 64 print

[1] The price quotations are for No. 2 Southern, Cincinnati.

cloth. The activity of the mills and the strength of the market in 1906–07 are reflected in the rise in price, this rise holding until after the panic actually occurred. The sales had been heavy in 1906 and the first half of 1907, and fell off in July of the latter year only because the mills were getting so far behind on their deliveries. In fact premiums were being offered to the mills on orders for immediate delivery.

This demand for cotton cloth had nearly wiped out the stocks of cloth on hand in the leading primary markets,[1] as is indicated



by the curve for stocks of print cloth given on Chart V. These statistics are perhaps not as accurate as those for sales, but undoubtedly show the general situation. The market decline to the low point in July, 1907, is especially significant when considered in connection with the price curve. The accumulation of stock after the panic shows that it was then that over-production occurred and has a strong bearing upon the general theory of crises.

Another index of the condition of the cotton manufacturing industry is the margin between the price of raw cotton and the

[1] The primary markets are New York, Boston, Providence, and Fall River. These statistics were compiled from the tables in several editions of A. B. Shepperson's *Cotton Facts*.

price of cloth. This is found by deducting from the price of cloth the cost of the quantity of raw cotton required to manufacture that cloth. This margin covers the manufacturing expense and the manufacturer's profits. In the months preceding the panics of 1893 and 1907, there was in each instance a sharp rise in this margin.[1] The margin reached its lowest point when the depression was most severe.

(16) *Silk.* The condition of the silk industry should be shown approximately by the imports and prices of raw silk. All of the raw material used in the industry in this country is imported, and the importations adjust themselves fairly closely to the demand from the manufacturers. In fact this is probably a better index to the industry than any figures for production would be, since the products are highly diversified. During the months preceding the panic of 1907 relatively large imports were received and there was a marked rise in price, the highest point being reached in May, 1907, after which a fall began.[2]

(17) *Tin.* As another illustration of the use of statistics of imports and prices for a raw material not produced in the United States, tin may be taken.[3] The domestic production of this commodity is negligible. The imports of tin, like those of silk, fluctuate somewhat irregularly, owing probably to the irregularity in the arrival of the ships in which the material is carried. But they were heavy in 1906 and the first part of 1907. The price of tin also showed a striking rise during the boom period preceding the panic of 1907, with a slight break in June and the beginning of a sharp decline in August of that year.[4]

(18) *Hides and Leather.* For the shoe manufacturing industry no statistics of production, sales, or prices are now to be had, and

[1] A chart showing this margin for the years 1881–1910 is given in my book, *The Cotton Manufacturing Industry of the United States*, p. 174.

[2] The statistics for imports are published in the *Monthly Summary of Commerce and Finance*, and the price statistics in the *New York Journal of Commerce.*

[3] Price statistics from *Engineering and Mining Journal.*

[4] The statistics from which these conclusions for tin are drawn were collected by several students in my class in Business Statistics in the Harvard Graduate School of Business Administration. Other students have collected figures on cotton cloth prices and margins and on the prices of hides and leather, which have been of assistance.

for hides and leather the only figures are for prices.[1] The most sensitive price statistics appear to be the quotations for Packers' No. 1 hides and Buenos Aires sole leather. Each of these fluctuates with the conditions in the industry, and in 1905 and 1906 both showed a general upward movement which culminated in January and February, 1907. The drop which occurred in the following months presaged still greater weakness in the future.

One complex phenomenon stands out clearly in a study of the price movements for these various commodities. The breaks in some instances preceded the panic by several months, whereas for other commodities the prices held up till the panic actually occurred. Through a more exhaustive study it may be possible to arrive at definite conclusions with reference to the laws of sequence. In other words, a correlation may be established which will serve as an accurate index to events likely to follow in the future. For this purpose an investigation of the changes in the prices of individual representative commodities will clearly yield better results than a study of a composite index number of prices.

(19) *Crops.* The prosperity of the country is dependent in no small degree upon the agricultural crops. Abundant crops mean better supplies of food for the population and more raw materials for the manufacturers of flour, cotton cloth, and other products. They also mean more purchases by the farmers of commodities of all sorts and more freight for the railroads. Unless the agricultural sections of the country are prosperous business is inevitably dull.

So far as my investigations have gone it appears that the best index to the farmer's prosperity is the average yield per acre. True, the price which the farmer receives is an important factor, and is not to be neglected. But the higher prices in years of short crops are beneficial to only a portion of the farming community. If some farmers receive relatively large amounts for their crops while others have their incomes seriously curtailed, the gross amount of farmers' purchases is not greater and the distribution is not normal. An even distribution is most beneficial to business in general.

[1] *Dun's Review; Shoe and Leather Reporter.*

There is the additional difficulty, when attention is given chiefly to the prices for agricultural products, of ascertaining what proportion of the crop is sold at each price. Just how much the farmers receive is more or less in doubt. Further, production is to be watched with caution, because it does not adjust itself to price changes in the same way as the production of pig iron, for instance. The forces of nature influence the agricultural yield. Although further investigation is needed to prove conclusively whether the yield per acre or the total yield and the price statistics are most significant, crop statistics of some kind clearly ought to be considered in any study of business indices.

(20) *Other Items.* In addition to the above indices there are several others for which statistics may be had after some delay or for which incomplete statistics are available. Unemployment statistics are a valuable index, as is proved by the report issued from month to month by the British Board of Trade. In this country, unfortunately, no unemployment statistics are currently available. The Massachusetts Bureau of Statistics has published quarterly statements on unemployment since March, 1908. The New York Bureau of Labor keeps monthly records of unemployment, but up to the present time these have been published only after so long an interval as to give them little more than historical interest.

For lumber some scattered statistics of production and shipments are published and also some price statistics. Unfortunately the quotations for lumber prices in trade papers are not altogether reliable. Judging from the statistics given in Part IV of the Bureau of Corporations' *Report on Lumber*, accurate price statistics for certain grades of lumber, especially for the common grades of fir and pine, would be as valuable indices as are the price statistics of other commodities.

Newspaper and book-paper prices are regularly published, but they too seem to be unreliable. Furthermore, paper is sold largely upon contracts extending over a year or more, so that the prices are somewhat inflexible. The American Pulp and Paper Association has been collecting reports of production and these were for

a time published.[1] From such material as is available, it appears that the paper trade is sensitive to fluctuations in general business conditions. The volume of advertising which the newspapers and magazines carry varies with business prospects and the size of the publications is thereby affected. When business is brisk there is also a greater demand for paper for posters, circulars, advertising booklets and for other purposes. For advertising itself some statistics are available,[2] but not enough to be of much service as yet.

The National Association of Wool Manufacturers began in December, 1913, to collect quarterly reports of the number of cards, combs, spindles, and looms in operation and idle in the woolen and worsted mills. If these reports are continued, they should prove valuable indices, even if they are not upon a monthly basis.

It is apparent, I think, from what has been stated in the foregoing paragraphs, that there is now abundant material for experimentation on this subject of business indices. In order to use these statistics properly some common basis of comparison is needed, which will not only provide a common denominator but which will also take into account the seasonal fluctuations. It is of vital importance to know whether an increase or a decrease represents a normal seasonal fluctuation or whether it represents a fundamental change in conditions. We now turn to a critical examination of the attempts which have been made to provide such a common denominator and to construct business barometers.

Some Methods of Business Forecasting

The systems of business forecasting which are now in use are open to criticism in two directions: (1) their selection of statistics and (2) their statistical methods. Such criticism does not imply a lack of appreciation of the useful service done by these "barometers." Their pioneer work has been especially valuable in creating amongst business men a more wide-spread interest, and a broader recognition of the fact that crises and depressions are not caused by politics or accidents.

[1] In the *Paper Trade Journal*. [2] *Printers' Ink* gives monthly tables.

(1) *Babson's Composite Plot.* One of the best known business barometers is that prepared by Mr. Roger W. Babson, who also publishes a very serviceable compilation of monthly statistics on his *Desk Sheet.* Statistics for twelve subjects are used in the preparation of this barometer, — (1) immigration, (2) new building, (3) liabilities of business failures, (4) bank clearings, exclusive of New York City, (5) Bradstreet's index number for commodity prices, (6) surplus reserves of the New York Clearing House banks, (7) foreign money rates, (8) domestic money rates, (9) conditions of crops, (10) idle cars, (11) political factors, (12) stock market conditions. The first four are grouped together as representing mercantile conditions, the second four as representing monetary conditions, and the third four as representing investment conditions.

From what has been said in the preceding pages it is evident that these statistics vary greatly in significance. Immigration, for example, is a much less reliable index than bank clearings or domestic money rates, and idle car statistics are altogether unsatisfactory. Furthermore, the methods of obtaining statistics for three of the subjects are open to serious criticism. In order to get an index for foreign money rates the official rates of the Bank of England, Bank of France, and Reichsbank are averaged. Such an average does not seem to me statistically sound, since the policies of these banks are by no means the same. The Bank of France, for instance, sometimes puts a premium upon gold deliveries instead of changing the discount rate. For crops only corn and wheat statistics are used. The cotton crop, which provides about one-fourth of our exports and affects so large a section of the country, is not included. The estimated crops of corn and of wheat, in bushels, are added together, despite the fact that in this way corn is given a weight four times that of wheat, which sells at considerably higher prices per bushel and is more of a cash crop. Corn should be given a weight not over twice that of wheat. As previously stated, the figures for total production seem to me less satisfactory for this purpose than the average yield per acre. "Political factors," finally, cannot be measured statistically, and to include such a subject indicates a startling

disregard for scientific method. An index of such factors could, at best, be only guess work.

Both Babson's selection of subjects and his treatment of the figures are open to criticism. If only twelve subjects were to be used in preparing the business barometer, these twelve should have been the most sensitive and the most trustworthy. Babson's selection seems to me to fall far short of that requirement. It is especially notable that no strictly industrial statistics are used. The selection of subjects, however, is open to less criticism than the methods of manipulating the statistics.

In order to secure a common basis of comparison for these diverse denominations and to eliminate the effects of seasonal fluctuations, a set of intermediary "scale" figures was worked out.[1] Taking immigration for illustration, a table of scale figures was prepared for each month. For January the highest and lowest figures for the month of January during the years of 1898–1908 were found, — 18,300 in 1901 and 56,200 in 1905. The range between these two figures was taken as equal to 100 points. The difference between the two actual figures (37,900) was divided by 10. By adding this quotient, 3,790, to 18,300, the point ten "degrees" above the lowest was found, and by repeating the process the entire scale was built up in arithmetical progression until it reached the highest actual figure, 56,200. The same scheme was used in working out a scale for each month. For February the lowest and highest figures for immigration in the month of February, 1898–1908, were found and a 100 point scale similarly ascertained, and so on for the other months. Thus there is a separate scale for each subject for each month.

To quote Mr. Babson's own explanation:[2] — "We then arrange the scale figures in column, placing zero over the column whose average approximates most closely to the average conditions of the years 1903 and 1904, — that is the depression following the 1903 panic. This date is taken arbitrarily as the starting point of the Barometer. We then place our index figures in series to the left and right of zero. If the volume of business increases

[1] "Preparing the Composite Plot," *Babson's Reports*, 1912.
[2] *Ibid.*

so as to go beyond the scale, higher scale figures are added, using the same arithmetical progression as at first, so that the actual condition of the years 1898–1908 serves as a *constant* by which to compare succeeding years. Scales similar to this one on immigration have been prepared for all subjects."

As an example of the way in which the immigration scales for January, February, and March are worked out the following table is given:—

	Jan.	Feb.	Mar.
+60	56,200	68,700	139,100
+50	52,410	64,170	128,440
+40	48,620	59,640	117,780
+30	44,830	55,110	107,120
+20	41,040	50,580	96,460
+10	37,250	46,050	85,800
0	33,460	41,520	75,140
−10	29,670	36,990	64,480
−20	25,880	32,460	53,820
−30	22,090	27,930	43,160
−40	18,300	23,400	32,500

On each scale the range would not necessarily be from − 40 to + 60, but in every case it would have a range of 100 points, with the lowest actual figure for that month, 1898–1908, at the bottom, the highest actual figure at the top, and "zero" fixed by the figures for 1903–04.

This scale is then used for determining the index figure for the current month. For January, 1914, for example, the number of immigrants was 44,700. This evidently falls between + 20 and + 30 on the January scale for immigration. 41,040 corresponds to + 20 on that scale. Subtracting from 44,700, the difference is 3,660. The last figure is then divided by 379, which is the value of each degree on the scale. The quotient, 9.6, is added to + 20, giving an index of + 29.6 for immigration in January, 1914.

An index number is similarly worked out for each of the subjects, by finding the scale figure to which the actual figure for the month of January, 1914, corresponds. Each month in each year is handled in the same way.

For business failures, surplus reserves, and idle cars, inverted scales are used, since these subjects vary inversely with business

conditions. But for surplus reserves, when the figures fall below a certain point, weakness rather than strength is indicated; hence, to quote Mr. Babson again, " below $5,000,000 this subject is put upon what we call a *deficit* scale, declining quickly to zero as the reserves are wiped out and reading – 66 for a deficit of $50,000,000, as in November, 1907." Similarly " when money rates for the best commercial paper reach about 5 per cent — an average occurring only in a period of excess loans — the scale figures begin to work downward again, for the ' lack of confidence ' shown by the high rate overshadows the ' excess of business ' feature shown by a majority of other subjects. On this panic scale the index moves to – 60 rapidly when rates advance from 5 per cent to 8 per cent or above." Both of these scales are purely arbitrary adjustments.

Having found the index for each of the subjects for a certain month these figures are averaged, giving double weight to bank clearings, domestic money rates, and the stock market index. The final figure thus obtained is the index to business conditions. Before undertaking to examine the use which is made of this summary figure, let us make a critical examination of this method of securing index numbers.

In the first place, it is evident that the index numbers are in no sense percentages. Since the lowest point is not zero, they do not show even the percentage of the range above the lowest points. The index numbers depend upon this range and upon the location of the zero point. The question of whether or not 1903–04 can fairly be assumed to have been representative of normal conditions for all of these subjects is of minor importance. The heart of the problem is the method of determinating the range upon which the scale figures are based.

The use of the range between the highest and lowest figures for each month over a ten-year period as a base for the scale figures presupposes that there were no abnormally high and no abnormally low figures in any instance. If in any month one subject showed an exceptionally high figure because of extraordinary circumstances which did not affect the other subjects and which had no influence in other months, the range was thereby made

abnormally wide. The scale figures and the index numbers determined from such a range are not properly comparable with those for other subjects and for other months. The range, in other words, may be said to have been placed at the mercy of the extraordinary events during this ten-year period. As a matter of fact, a little experimenting will show that the exclusion of a single high figure, using instead the one next in order, materially modifies the scale figures for any subject.

Take the liabilities of business failures, which showed as its high point $100,045,440 in October, 1907. The greatest force of the panic was then felt by that subject. Although in the following months failures were heavier than prior to the panic, they by no means exceeded the averages for the respective months to anything like the same degree as in October. Consequently the scale for liabilities of business failures for October is not fairly comparable with the failures scales for the other months. Again, as has already been shown, the approach and the effects of the crisis were not felt synchronously to the same degree by all the subjects. Domestic money rates, for example, reached their highest point in December in 1907,[1] and security prices their highest point in September, 1906. A brief examination of the statistics for the other subjects will show that there was no such correlation in their fluctuations as to warrant the use of this method of establishing a common basis of comparison or to justify the averaging of the index numbers.

The summary index figure which is obtained by averaging the index figures for the twelve subjects does not, therefore, indicate the percentage of anything, nor does it show the percentage change from month to month. It merely gives the average of the figures obtained by the use of this questionable range-scale method.

The summary figure is obtained solely for making the Composite Plot. The theory which underlies the Composite Plot is

[1] From the explanation which has been given of the "deficit scale" used for money rates when they rise above 5 per cent, the latter figure must have been taken as the maximum in fixing the scale. If this same plan were to be commonly followed, the scales would become entirely arbitrary, depending upon the judgment of the person who made them out.

that in business, as in the physical sciences, "action and reaction" are equal and that the summary index figure for the twelve subjects measures business action and reaction so accurately that we can foretell the amount of depression which will compensate for a preceding period of prosperity.

Though the rhythmic movement in trade cycles is not to be disputed, it is more than doubtful whether there is a law applicable to our ultra-complex economic life which causes an exact balancing of action and reaction. Some forces may tend to counterbalance each other at one time, and yet not at another. Furthermore there may be long delays in the manifestations of the resultants of certain forces. And even granting that a definite law of this kind is at work, are the twelve subjects for which statistics are used by Mr. Babson so representative of all business conditions and forces that we can base hard and fast conclusions upon them? Are the statistics themselves so free from error that they can serve as exact measures? Is the method of reducing these statistics to a common basis so scientifically accurate that the final composite index number deserves confidence? It is obvious that each of these questions must be answered in the negative.

Finally, the Composite Plot itself is to be considered. To obtain this the summary index numbers are plotted as for an ordinary graph, with the additional provision of a line of "normal growth,"—the X—Y line. This X—Y line is an essential part of the Composite Plot, since some of the subjects tend to show an increase from year to year in consequence of the growth of the country. If it were not for the growth of the country, the curve plotted from the index numbers would fluctuate above and below a straight line parallel to the base line. The line of "normal growth," however, must move upward in order to show a proper balance.[1]

As the summary index numbers are plotted upon the chart, a part fall above the X—Y line and a part below. There develop,

[1] It should be noted that for five of the twelve subjects there is no normal growth, but only fluctuations around the constant level. Money rates, for instance, do not necessarily increase with the growth of the country.

consequently, a series of areas bounded by this curve for summary index numbers and by the X—Y line. These areas alternate above and below that X—Y line. Those above are positive and represent action; those below are negative and represent reaction. Since action and reaction are to be equal, the positive and negative areas must be equal. They are not regular in depth or breadth but equal only in area. For a current month this Composite Plot is assumed to show the position in which the business world is with reference to the business cycle. From this Plot, it is assumed, one can judge how much positive or negative area can be expected to develop before a change sets in. The Plot does not indicate in any way whether this development is likely to be rapid or slow, whether the "reaction" will be sharp and quick or slow and long.

Obviously the relative size of the areas above and below the X—Y line depends upon where that line is placed. When this Plot was first published, the X—Y line was straight. Its direction had been determined by carrying the Plot back over several years and drawing the line of normal growth in such a way that equal positive and negative areas would be shown.

Until January, 1913, the line continued to be straight, running diagonally at an angle of about ten degrees from the horizontal. Events, however, were causing unequal areas to develop and a readjustment was necessary. Modifications in the direction of the X—Y line were introduced, causing long, irregular fluctuations. Had the direction of the line remained unaltered, the appearance of the plot at the present time would be quite different. Now the direction of the X—Y line is changed as occasion requires. To quote from an explanation issued by the Babson Statistical Organization:

"After considerable study of the different subjects, it seems clear that the subject most successful as an indicator . . . is the volume of bank clearings for the country, excluding New York. . . . But as it is always dangerous to use one subject alone and especially a subject reflecting surface movements, it is necessary to take bank clearings as an indicator only, and to check conclusions based upon it at the end of each year by all the important

barometers of wealth which are reported annually, and again at the end of each cycle, as shown by the areas of the Composite Plot. *Therefore, on our Composite Plot, the line X—Y is now drawn so as to make the areas equal,*[1] with special attention to the cycles." [2]

In other words, without offering a detailed explanation, the X—Y line is now adjusted from time to time according to bank clearings, one of the twelve subjects used in obtaining the barometer figure, and, in the long run, the line is drawn so as to make the positive and negative areas equal. In last analysis, therefore, the whole scheme turns upon the X—Y line, which is readjusted more or less in accordance with what the manipulator thinks that the chart ought to show.

(2) *Brookmire's system.* The other system of forecasting which I shall examine here is that of the Brookmire Economic Chart Co. In this system there are three composite indices and no single plot. No attempt is made to lay down rules that the indices must always react upon each other in the same way or that any hard and fast law is to be followed. It is recognized that many forces are at work which cannot be expressed statistically but which must be taken into consideration in judging the probable course of business conditions.

In obtaining the Business Index the following statistics are used: [3] total bank clearings in the United States, bank clearings exclusive of New York City, commodity prices, railroad gross earnings, new building (70 cities), pig iron production, pig iron price, price of Bessemer billets, unfilled orders of United States Steel Corporation. For the Stock Market Index, the average price of twenty railroad stocks and twelve industrials is computed; and for the Banking Index, use is made of loans, deposits, reserves, ratio of reserves to loans, and rate on commercial paper.[4]

[1] The italics are mine.

[2] "How the Line of Normal Growth 'X-Y' of the Composite Plot is Located," *Babson's Reports*.

[3] J. H. Brookmire, "Financial Forecasting," *Moody's Magazine*, January, 1914, p. 8.

[4] *Ibid.*, June, 1913, p. 444.

The method of reducing these statistics to a common basis has been explained by Mr. Brookmire as follows: "In combining these banking indices it was necessary to create a common scale on which to place each index before averaging them all together. I decided to take a period beginning with 1900 and find the average figure for each index taken. This 'normal' or 'zero' point is the place where the points of each index used fall half above and half below the normal line. For example, the 'normal' or 'zero' point of the loans to deposits graph is 98.5 per cent for the period 1900 to 1912. This 'normal' or 'zero' point is the starting point of the new combined index."[1] That is, the median is apparently used as the standard in working out the scale.

In criticizing this system of forecasting, attention is first to be called to the limited number of subjects included and to the omission of all crop statistics. But, here again, the main criticism lies against the technical methods used in making adjustments for seasonal fluctuations and for normal growth. For those statistics which manifest a seasonal fluctuation, the seasonal variation is calculated and, before the index is prepared, the statistics are "compensated" in accordance with these calculations. Owing to the nature of the statistics a certain percentage of error must be involved in these calculations and compensations.

As regards "normal" growth, the rate of annual increase in those figures which are influenced directly by the progressive advance of the country is also calculated, and the figures are "stepped down" before using.[2] Since so many diverse forces affect these statistics, a rate of "normal" annual increase can, at best, be only an approximation; whereas the system presumes to make a nice adjustment. Obviously both the "compensation" and the "stepping down" are somewhat arbitrary, depending more or less upon the judgment of the person preparing the index. A system in which the personal element is dominant, as in this case, is always open to doubt. It does not tell its whole story upon its face.[3]

[1] J. H. Brookmire, "Financial Forecasting," *Moody's Magazine*, June, 1913, p. 444.

[2] *Ibid.*

[3] A reply to these criticisms was published by Mr. Warren F. Hickernell, editor

Suggested Method of Obtaining Indices

It is apparent, from the criticisms which have been made in the preceding section, that one of the fundamental problems in preparing indices of business conditions is to secure a common denominator which will allow for normal growth and seasonal fluctuations without leaving any of the adjustments or compensations to personal judgment or manipulation. To achieve this end I suggest the following method.

For each subject let a monthly index number be obtained by dividing the actual figure for the month by the average for that month during the ten preceding years. This is illustrated by the table on the next page, which gives the ten-year monthly averages, the actual figures, and the index numbers, for one item, namely bank clearings, exclusive of New York City, the period covered being the years 1913 and 1914. The figures for clearings are from *Bradstreet's*.

The ten-year average for the month of January, 1903–12, was $4,903,000,000; the actual amount for January, 1913, $6,739,-000,000. Dividing the latter by the former, an index number of 137 is obtained. This means that in January, 1913, bank clearings were 37 per cent above the ten-year average for that month. The ten-year average for February, 1903–12, was $4,142,000,000 and the actual amount in February, 1913, $5,670,000,000, which also gives an index number of 137. Similarly for each month in 1913 the actual number is divided by the average for that month during the years 1903–12. For January, 1914, the actual amount, $6,687,000,000 is divided by $5,193,000,000, the ten-year average for January, 1904–13; and a similar base is used for the other months in 1914.

By means of this moving base the comparability between the index number for December, 1913, and that for January, 1914, is maintained. The basic months used in obtaining the index for January, 1914, bear the same relation to the basic months used in obtaining the index number for December, 1913, that the latter

of the Brookmire Economic Service, in *Moody's Magazine*, December, 1915, pp. 574–578.

bear to the basic months for November, 1913. By using the ten-year monthly averages, seasonal fluctuations are automatically allowed for, and by always taking the ten preceding years as the base, provision is made for normal growth.

The ten-year monthly average represents a normal standard, whether the figures tend to increase or to fluctuate about a constant level. For the purpose in hand this moving base seems superior to a fixed base and certainly it is more reliable than any arbitrary scale. It may prove advisable to use a fifteen or a twenty-year period in determining the bases, in order to reduce the influence of exceptional years. The principle, however, will remain the same. The ten-year period facilitates the use of those

BANK CLEARINGS

Month	Base (Average for Month, 1903–12)[1]	Actual Figures[1]	Index Number
1913, January	4,903	6,739	137
February	4,142	5,670	137
March	4,728	6,100	129
April	4,612	6,090	132
May	4,565	6,025	132
June	4,549	5,831	128
July	4,639	6,080	131
August	4,350	5,492	126
September	4,407	5,841	132
October	5,162	6,859	133
November	4,913	6,157	125
December	5,041	6,536	130
	Base (Average for Month, 1904–13)[1]		
1914, January	5,193	6,687	129
February	4,392	5,500	125
March	4,985	6,263	126
April	4,794	6,218	130
May	4,732	5,797	122
June	4,767	5,968	125
July	4,872	6,180	127
August	4,577	5,233	114
September	4,657	5,269	113
October	5,460	5,981	110
November	5,180	5,551	106
December	5,321	5,979	112

[1] In millions.

statistics which have not been collected for a longer time and, from numerous experiments which I have made with a wide variety of statistics, the ten-year period appears to be satisfactory.

In plotting the index numbers I have in each case represented 100 by a heavy line. This is the norm shown by the ten-year monthly averages. As long as a curve remains above this line, the figures are above normal, that is, above the ten-year average for the corresponding months.

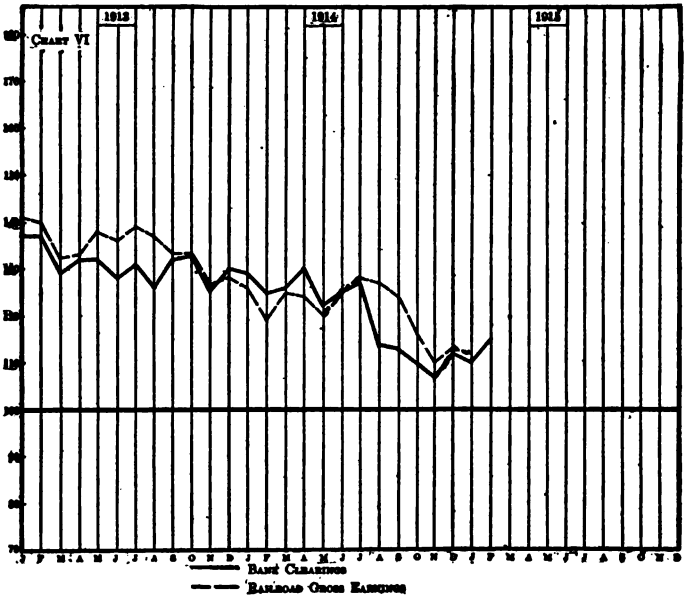
The general method is illustrated by Charts VI, VII, and VIII, which show the course of the index numbers for bank clearings, railroad gross earnings, number of business failures, commodity prices, stock market, money rates, crops, and pig iron. The war has brought hardships untold to the statistician who wishes to study the indices of business conditions. It has led to the discontinuance of certain statistics, and a change in the form of others. The Copper Producers' Association, for example, ceased publishing figures for the production of copper. The *Boston Transcript* reduced the number of stocks used in obtaining its barometer from twenty-five to twenty, and several other sets of statistics were upset. The charts here represented are only a part of those which have been worked out in my experiments, but they will suffice to explain this method of presentation.

The bank clearing statistics used are those published monthly by *Bradstreet's* for the United States exclusive of New York City. The statistics for the number of business failures and also the index number for commodity prices are from *Bradstreet's*. Railroad gross earnings are for ten roads as given on Babson's desk sheet. The stock market barometer is that of the *Boston Transcript*. Money rates are represented by the average monthly rate on 60–90 day commercial paper in New York. For each of these subjects the index numbers from which the curves were plotted were obtained by dividing the actual monthly figures by the averages for the corresponding months during the ten preceding years.

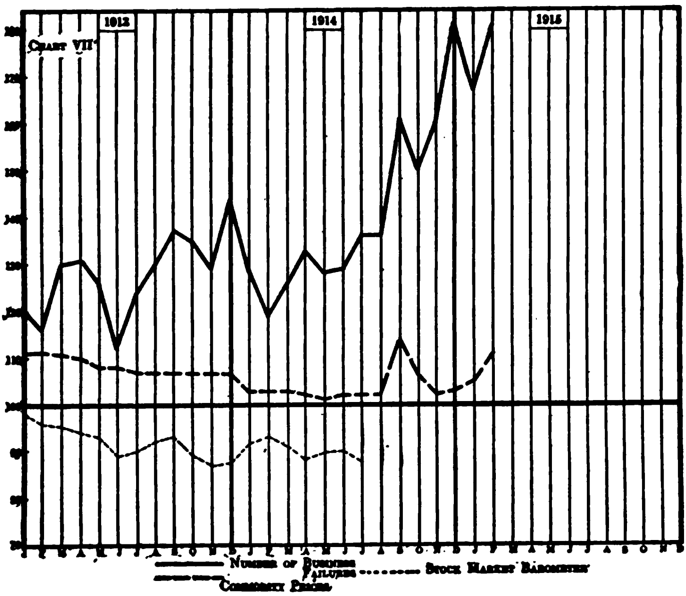
For pig iron an index number for production was worked out upon the same general plan. Then in the same way an index number for price. In order to get a single index number for pig

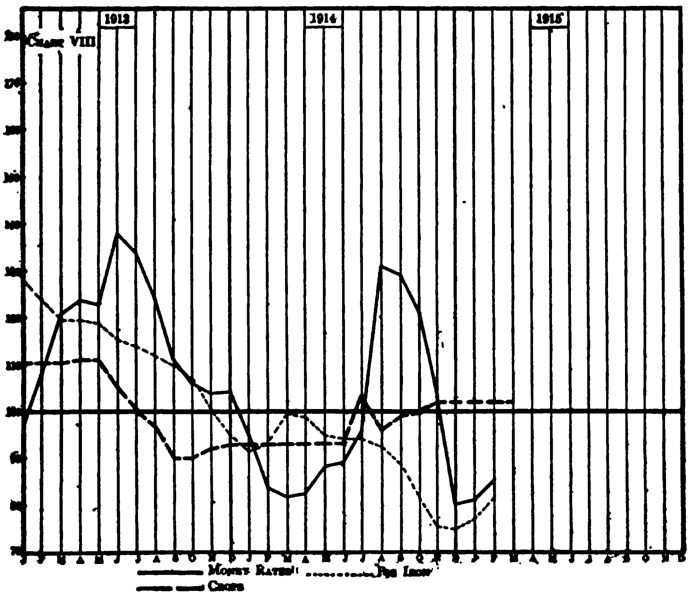
iron which should show the net result of changes both in production and in price I have averaged the production index with the price index. For example, the production index for January, 1913, was 157.5, the price index 99.5, and the average index, therefore, was 128.5. It may prove better to use these two indices separately, but this combined index seems worth trying and watching.

For crops the index number has been prepared first for winter wheat, spring wheat, corn, and cotton. Other crops might be



added, but these serve to represent the conditions in the great agricultural sections of the country. During the growing season the condition reports of the United States Department of Agriculture are used. The index number for each of these crops for each month during this season is found by dividing the condition figure for the month by the ten-year average for the same month. When the final report of the Department of Agriculture is issued the yield per acre is taken as the best index and the index number for each crop is found by using as a base the average yield per acre for that crop during the preceding ten years. From December,


1913
1914
1915
Failures


1913
1914
1915
Crops

when the final report of the Department of Agriculture is issued, till the new condition reports begin in the following spring, the index numbers for the crops remain constant. These constant index numbers during the winter and early spring give a proper representation of conditions, since the influence of the crops on the markets is practically without change during that time.

After the index for each of these crops was prepared, a weighted average was taken.[1] Winter wheat was given a weight of one, spring wheat one, cotton two, and corn four. This weighting corresponds roughly to the relative total value of each of these crops. The final weighted average was taken as the crop index, which was to represent trade conditions in the leading agricultural districts.

Looking at the charts here given, it is apparent, I think, that they fairly represent some of the conditions prevailing during this period. The indices for bank clearings and railroad gross earnings (Chart VI) correlate closely and show the general trend of events. The number of business failures (Chart VII) has been relatively high throughout, jumping sharply upward after the outbreak of the war. As regards the future, in view of the length of time during which failures have been relatively heavy, this is a favorable indication; there has been an unusually severe liquidation and the weak spots must have been pretty thoroughly cleaned out. The price index tended to fall until the war came. The stock market showed continued depression.

Chart VIII is, perhaps, most helpful in interpreting the general course of business during these months. The rise in money rates, in the early part of 1913, was due to the Balkan war. This was probably one of the primary causes of the business depression which began in the United States early in 1913. The decline later in the year was accompanied by a brightening of business prospects in the fall of 1913. Most industries showed an appreciable improvement about September of that year, but this improvement did not hold. The sharp decline in crop prospects which began in June, 1913, at just the time when the index for

[1] Further experiments are being carried on to ascertain whether an average index or a separate index for each crop is more satisfactory.

money rates was at its highest point accentuated the depression which was setting in and helped to cause the slight crisis of that month. The relatively poor crops, as indicated by this curve, show why there was not more recovery in the fall and winter of 1913 and why business was depressed during the entire spring of 1914. Since other factors were favorable and the crop outlook brighter in the summer of 1914 conditions appeared ripe for at least a moderate business recovery. The breaking out of the European war, however, suddenly tightened the money market and upset the whole business world.

The pig iron index is added to this chart, not as an index of all industry, but as an illustration of this method of comparisons. One of the merits of this form of presentation is that the various factors can be studied separately and evaluated. A composite index figure for numerous diverse subjects may cover up significant changes, which cannot properly be considered as counterbalancing each other.

At the present time satisfactory and reliable statistics are available for only a very few industries. We have no adequate record of the changes which are taking place from month to month in the symptomatic manufacturing industries and in the wholesale and retail trades. But before we can thoroughly understand the complex causes of industrial crises, we must know vastly more of the actual conditions in various industries and trades. Possibly we shall no longer have serious panics, thanks to our new banking system; but we shall unquestionably be subject to fluctuations in industry, and probably crises will recur from time to time. Measures to prevent serious depression must reach much farther than to the banking system. Although crises are manifested most strikingly in the financial field, which serves to bind together the whole business world, they have their roots and causes in industrial conditions. Hence the sooner the collection of more comprehensive statistical records for industry and trade is begun, the earlier can we acquire a thorough knowledge of the fundamental forces which affect business prosperity.

II. Current Theory Concerning Business Cycles [1]

By Wesley C. Mitchell

TYPES OF THE EARLY THEORIES OF CRISES

Serious efforts to frame a theory of business cycles began with the contemporary discussions of the economic crisis of 1825.[2] Differences of opinion promptly appeared regarding the cause of this widespread dislocation of trade — differences which multiplied as the crises of later years brought new materials and new men into the discussion. Presently crises became one of the accredited topics of economic theory, and systematic writers began to develop explanations based upon their doctrines of production, distribution, and exchange. Before the end of the nineteenth century there had accumulated a body of observations and speculations sufficient to justify the compilation of histories of the theories of crises.[3]

Inevitably, the early efforts to account for the exceedingly complex phenomena of crises were crude and superficial. But the problem commanded so much attention that the character of the treatment rapidly improved. Each recurring crisis, indeed, produced a fresh crop of ill-considered explanations; but meanwhile other writers were steadily using and bettering the work of their predecessors. In this process of elaboration, however, the early differences of opinion did not disappear. Instead they became standardized into several distinct types of theory, each represented in the growing literature by a number of variants.

First may be put the view that crises are "abnormal" phenomena, produced by some disturbing event such as the intro-

[1] Wesley C. Mitchell, *Business Cycles*, pp. 3–6, 19–20. Reprinted by permission of University of California Press.

[2] E. von Bergmann, *Geschichte der nationalokonomischen Krisentheorien* (Stuttgart, 1895). As usual, research has discovered a number of fragmentary discussions by earlier writers. See the opening pages of von Bergmann's successive chapters.

[3] Von Bergmann's book, cited in the preceding note, is the most elaborate. The best histories in English and French are E. D. Jones's *Economic Crises* (New York, 1900), and J. Lescure's *Les crises générales et périodiques de surproduction* (Paris, 1907), pp. 433–522.

duction of revolutionary inventions, the development of new means of transportation which alter old trade-routes, wars, the revision of tariffs, fluctuating monetary standards, crop failures, the unexpected bankruptcy of some conspicuous business enterprise, changes in fashion, and the like. Such explanations proceed upon the assumption that the equilibrium of economic activities has become so delicate that it may be disturbed by untoward conjunctures of the most dissimilar kinds, and point to the conclusion that each crisis has its own special cause which must be sought among the events of the immediately preceding years.[1]

Next in formal simplicity is the type of theory which ascribes crises to "inflation." An increase in coin, in irredeemable paper money issued by the government, in bank-notes, or in deposit currency produces an advance of prices. The latter stimulates business to great activity, which runs to extremes in reckless investments and feverish speculation, and ends in a crash of credit and widespread bankruptcy.

The "over-production" and "under-consumption" theories contend that, owing to the efficiency of modern machinery, the power of society to produce has outstripped its power to consume. Hence the periodical occurrence of "general gluts" — paradoxical situations in which superabundance causes want. Unable to sell their increasing output of goods at remunerative prices, employers are forced to close their factories and turn away their hands — a remedy which aggravates the disease by reducing yet more the community's power to purchase for consumption.

To the classical economists the theory of general over-production was a heresy, which they perseveringly sought to extirpate by demonstrating that the supply of goods of one sort necessarily constitutes demand for goods of other sorts. But maladjusted production they allowed to be possible, and their theories of crises usually sought to show how maladjustment comes about through the sinking of capital in unremunerative investments. Such locking-up of capital was often held to be one result of "the tendency of profits to a minimum." When this tendency has

[1] Jones gives a good analysis of this type of theories in his second chapter. Roscher is perhaps the best known representative.

reduced the current rate of profits to an unaccustomed level, the less sagacious capitalists become dissatisfied and embark in ill-considered schemes. There results the production of goods for which no market can be found, business failures, and the loss of confidence — in short, a crisis which extends over all lines of trade.

Another group of economists, among whom Schäffle was prominent, accepted ill-adjusted production as the cause of crises; but accounted for it by the complexity of modern economic organization. Not only are manufacturers compelled to produce goods months in advance for a market whose changes they cannot forecast, but investors are compelled years in advance to put their funds into enterprises the need of which is uncertain. A close coördination between supply and demand is not possible. The mistakes which are made should be ascribed less to avoidable errors of judgment than to the planlessness of capitalistic production.

But the most vigorous attempt to prove that crises are a chronic disease of capitalism is that made by Rodbertus, Marx, and their followers. The gist of the socialist contention is usually that the laborer receives as wages much less than the real value of his product. Hence the demand for consumers' goods, which must depend largely upon the great mass of wage-earners, fails to keep pace with the increase of the output. Meanwhile, the capitalist-employers are investing their current savings in new productive enterprises, which presently begin to add their quotas to the market supply. This process runs cumulatively until the time comes when the patent impossibility of selling goods at a profit brings on a crisis.

So bald a statement as the preceding falls far short of doing justice to the nineteenth century writers upon crises; but it suffices to indicate the foundations upon which our contemporaries have built their more elaborate explanations. The latter conserve all of permanent value which the earlier economists achieved, and contain in addition certain fresh contributions to the subject.

CURRENT THEORIES OF BUSINESS CYCLES

Two Points of Agreement

Wide divergences of opinion continue to exist among competent writers upon crises; but in recent years substantial agreement has been reached upon two points of fundamental importance.

Crises are no longer treated as sudden catastrophes which interrupt the "normal" course of business, as episodes which can be understood without investigation of the intervening years. On the contrary, the crisis is regarded as but the most dramatic and the briefest of the three phases of a business cycle — prosperity, crisis, and depression.[1] Modern discussions endeavor to show why a crisis is followed by depression, and depression by prosperity, quite as much as to show why prosperity is followed by a crisis. In a word, the theory of crises has grown into the theory of business cycles.[2]

This wider grasp of the problem has discredited the view that crises are due to abnormal conditions which tempt industry and trade to forsake their beaten paths and temporarily befog the judgment of business men and investors, or to misguided legislation, unsound business practices, imperfect banking organization, and the like.[3] As business cycles have continued to run their round decade after decade in all nations of highly developed business organization, the idea that each crisis may be accounted for by some special cause has become less tenable. On the contrary, the explanations in favor today ascribe the recurrence of crises after periods of prosperity to some inherent characteristic

[1] The not infrequent statement that prosperity sometimes merges into depression without the intervention of a crisis means simply that the writers understand by crisis a violent disturbance of business conditions. It is in closer accord with everyday usage to call such occurrences "panics," and to apply the term "crisis" to the transition from prosperity to depression even when accomplished quietly. On closer inspection, a business cycle is often found to be complicated by minor changes, such as the interruption of depression by a premature resumption of activity, the occurrence of a pause or even a slight crisis in the midst of prosperity, and the like. But for the present it is wise to confine attention to the broadest features of the cycle.

[2] Compare W. Sombart, "Versuch einer Systematik der Wirtschaftskrisen," *Archiv für Socialwissenschaft*, 1904, pp. 1–21.

[3] The first type of theories mentioned in the preceding section.

of economic organization or activity. The complex processes which make up business life are analyzed to discover why they inevitably work out a change from good times to bad and from bad times to good. The influence of special conditions is admitted, of course, but rather as a factor which complicates the process than as the leading cause of crises.

THE METHOD OF INVESTIGATION

Beveridge ascribes crises to industrial competition, May to the disproportion between the increase in wages and in productivity, Hobson to over-saving, Aftalion to the diminishing marginal utility of an increasing supply of commodities, Bouniatian to over-capitalization, Spiethoff to over-production of industrial equipment and under-production of complementary goods, Hull to high costs of construction, Lescure to declining prospects of profits, Veblen to a discrepancy between anticipated profits and current capitalization, Sombart to the unlike rhythm of production in the organic and inorganic realms, Carver to the dissimilar price fluctuations of producers' and consumers' goods, Fisher to the slowness with which interest rates are adjusted to changes in the price level.[1]

[1] In order to bring out the salient points which differentiate the several theories reviewed above, I have been obliged to omit much effective detail and all corroborating evidence. In particular most writers show how the operation of the factors upon which they lay stress is reënforced and quickened by speculation. Two contributions to this important aspect of the subject deserves especial mention — Petrazycki's book on speculation and joint-stock companies, and Edward D. Jones's chapter upon the psychology of crises. L. von Petrazycki, *Aktienwesen und Spekulation*, Berlin, 1906; E. D. Jones, *Economic Crises* (New York, 1900), ch. ix.

I have omitted Pohle's interesting attempt to base a theory of crises upon the steady growth of population on the one hand, and the unsteady growth of investment on the other hand, because he has recently shifted his emphasis. In 1902 he held that in order to have proper equipment ready for the regular number of new recruits who are ever joining the industrial army, it is necessary to produce machines, raw material, etc., in larger quantities than the force of old soldiers can use. But the irregularity with which savings are invested prevents this desideratum from being realized every year. In 1910 he agrees substantially with Spiethoff, holding that the chief cause of crises is the inequality in the formation of fixed and circulating capital, adding simply that the economic and social consequences of crises are aggravated by the regularity with which population increases even in times of depression. Ludwig Pohle, *Bevölkerungsbewegung, Kapitalbildung, und*

One seeking to understand the recurrent ebb and flow of economic activity characteristic of the present day finds these numerous explanations both suggestive and perplexing. All are plausible, but which is valid? None necessarily excludes all the others, but which is the most important? Each may account for certain phenomena; does any one account for all the phenomena? Or can these rival explanations be combined in such a fashion as to make a consistent theory which is wholly adequate?

There is slight hope of getting answers to these questions by a logical process of proving and criticizing the theories. For whatever merits of ingenuity and consistency they may possess, these theories have slight value except as they give keener insight into the phenomena of business cycles. It is by study of the facts which they purport to interpret that the theories must be tested.

But the perspective of the investigation would be distorted if we set out to test each theory in turn by collecting evidence to confirm or to refute it. For the point of interest is not the validity of any writer's views, but clear comprehension of the facts. To observe, analyze, and systematize the phenomena of prosperity, crisis, and depression is the chief task. And there is better prospect of rendering service if we attack this task directly, than if we take the roundabout way of considering the phenomena with reference to the theories.

This plan of attacking the facts directly by no means precludes free use of the results achieved by others. On the contrary, their conclusions suggest certain facts to be looked for, certain analyses to be made, certain arrangements to be tried. Indeed, the whole investigation would be crude and superficial if we did not seek help from all quarters. But the help wanted is help in making a fresh examination into the facts.

periodische Wirtschaftskrisen (Göttingen, 1902); "Konjunkturschwankungen und Konjunkturberichterstattung," *Zeitschrift für Socialwissenschaft*, January, 1910. Neither have I thought it necessary to include the superficial form of the under-consumption theory elaborated by Pierre Vialles in *La consommation et les crises économiques* (Paris, 1903). Finally, Mr. H. S. Jevons's ingenious attempt to revivify his father's "sun-spot theory" scarcely affords a convincing explanation of the business cycles with which this book is chiefly concerned. ("Trade Fluctuations and Solar Activity," *Contemporary Review*, August, 1909.)

III. Government Crop Reports [1]

Bureau of Crop Estimates, U. S. Department of Agriculture

Value of Crop Estimates

The practical value of the Government crop estimates results from the fact that they are based upon reports of farmers and others in every county and township in the United States and upon reports of trained field agents in each State; they are made monthly during the crop season; they are checked up from every possible source of information; the final reports are prepared and issued by a crop-reporting board of experts; and all Government employees engaged in the preparation of the crop estimates are prohibited by law from giving out information concerning them or in utilizing information so obtained for their own benefit directly or indirectly prior to the date and hour of publication, so that the reports when issued are known to be as accurate as it is practicable to make them, as well as impartial, disinterested, and therefore dependable. No public organization, and certainly no private corporation in the United States and probably in the world, is so well organized and equipped for the work of reporting on crop conditions and prospects as the present Bureau of Crop Estimates.

Without such a system of Government crop estimates, speculators interested in raising or lowering prices of farm products would issue so many conflicting and misleading reports that it would be practically impossible for anyone, without great expense, to form an accurate estimate of crop conditions and prospects. Farmers would suffer most from such conditions, because they are not so well organized as other lines of business nor are they in a position to take advantage of fluctuations in market prices.

Farmers are benefited by the Government crop reports both directly and indirectly; directly, by being kept informed of crop prospects and prices outside of their own immediate districts, and indirectly, because the disinterested reports of the Government

[1] *Government Crop Reports: Their Value, Scope and Preparation*, United States Department of Agriculture, Bureau of Crop Estimates, Circular 17, Revised, pp. 8–26.

tend to prevent the circulation of false or misleading reports by speculators who are interested in controlling or manipulating prices.

The farmer cannot, by refusing to report the condition of crops for his locality, prevent buyers and speculators from knowing the condition of the crop. It is well known that speculators and large dealers in farm products do not depend entirely upon Government reports for information concerning crop prospects. They maintain regular systems of their own for collecting crop information. They have traveling agents and correspondents (usually local buyers) throughout the United States who keep them posted, and the large buyer or speculator, in return, gives these local buyers or correspondents information in regard to general conditions and prices. The local buyers know the conditions of crops in their own vicinity better, as a rule, than the average farmer, because it is their business to keep well informed.

If the Government crop estimates should be discontinued the farmer would have no reliable information concerning crop prospects except in his own immediate neighborhood, and for crop prospects in other localities he would have to depend upon such information as interested speculators and dealers might choose to publish in the newspapers, which might or might not be correct. Prices in his own local market are influenced, as a rule, more by the condition of the whole crop throughout the State or the United States, and even in foreign countries, than they are by local conditions. The entire wheat crop of his county may be destroyed and yet prices may be low, or his county may have a bumper crop and prices be unusually high, depending upon whether or not there is a surplus or deficiency in the entire crop elsewhere. In a sense the Bureau of Crop Estimates is a form of farmers' coöperation, wherein each farm crop reporter gives information about his locality and in return receives information about the entire country, the bureau merely acting as a clearing house for such coöperative exchange.

Some of the private crop reports which are published in the newspapers are honestly prepared and are more or less accurate, depending upon the extent and sources of information; on the

other hand, misleading crop reports are known to be frequently circulated in order to raise or lower prices in the interest of speculators. If the farmer reads the crop estimates and forecasts of the Government as they are issued he will be in a position to judge for himself what the crop prospects are, as well as probable prices, so that he can decide intelligently how to market his produce and how to deal with the local buyers. Even the farmers who do not keep posted are indirectly benefited by the publication of Government crop estimates, because these estimates automatically tend to check and lessen the injurious effects of false reports sent out broadcast by interested speculators and their agents, in the same way that a police or constable force tends to check but not entirely prevent crime in a community.

The more certainty there is as to the probable supply and demand the less chance for speculation and loss in the business of distributing and marketing the crop, which is a benefit both to the producer and to the consumer.

Large manufacturing firms, agricultural implement and hardware companies, who neither buy nor sell farm products, are much interested in crop prospects. This knowledge enables them to distribute their wares economically, sending much to sections where crops are good and farmers will have money with which to buy, and less to sections where crops are short and farmers will have less to spend. Few farmers realize how much is saved by an even distribution of manufactured articles according to crop prospects. If manufacturers avoid heavy losses from improper distribution, they can afford to sell on better terms, with resulting benefit to farmers.

The railroads of the country, which move crops from the farm to the market, must know in advance the probable size of the crop in order to provide a sufficient number of cars to handle it effectively and without delay. Cases are not infrequent when prices of grain at railroad stations are reduced, or there is absolutely no sale for the grain, because cars are not available for shipping, the farmer thus being among the sufferers.

Prompt and reliable information regarding crop prospects is equally important and valuable in the conduct of commercial,

industrial, and transportation enterprises. The earlier the information regarding the probable production of the great agricultural commodities can be published, the more safely and economically can the business of the country be managed from year to year.

Retail dealers in all lines of goods, whether in the city or in the country, order from wholesale merchants, jobbers, or manufacturers, the goods they expect to sell many weeks and frequently many months before actual purchase and shipment. Jobbers follow the same course, and manufacturers produce the goods and wares handled by merchants of every class far ahead of the time of their actual distribution and consumption. It is therefore important that they have the earliest information possible with respect to crop prospects and the probable purchasing power of the farmers.

With such information carefully and scientifically gathered and compiled, and honestly disseminated, so that it can be depended upon to be as accurate as any forecast or estimate can possibly be, and relied upon as emanating from an impartial and disinterested source, the farmers, the merchants, the manufacturers, and the transportation and distributing agencies of the country can act with a degree of prudence and intelligence not possible were the information lacking.

Scope of Crop Reports

Beginning with planting, data are gathered and reports made as to the condition and acreage of each of the principal agricultural products, such as corn, wheat, oats, rye, barley, potatoes, hay, cotton, tobacco, rice, etc. As the crops progress the prospects are reflected in monthly condition reports upon each growing crop; such reports being expressed in percentages, 100 representing a normal condition. Condition reports, expressed in percentages of a normal, when published, are coupled with a statement of the averages of similar reports at corresponding dates in preceding years (usually 10-year averages); by such comparison the condition of crops in comparison with the average condition is readily obtained. At harvest time the yields per

acre are ascertained, which, being multiplied by the acreage figures already ascertained, give the production.

The tabulation which appears on pages 144 and 145 is designed to show, in abbreviated form, the scope of monthly crop reports of the Bureau of Crop Estimates, in 1914, and the time and nature of inquiry for each crop. Slight modifications may be made from time to time. Characters are placed under months in which reports are published. Explanatory key is given at the top of the tabulation.

Methods of Crop Reporting

The reports issued by the Bureau of Crop Estimates during the year include data relating to acreages, conditions, yields, supplies, qualities, and values of farm crops, numbers by classes, condition, and values of farm animals, etc. The data upon which such estimates are based are obtained through a field service consisting of a corps of paid State field agents and crop specialists and a large body of voluntary crop reporters composed of the following classes: County reporters, township reporters, individual farmers, and several lists of reporters for special inquiries.

The field service consists of trained field agents, one assigned to a single State or group of smaller States which in the aggregate corresponds in area and crop production to one of the larger States, who devote their entire time to the work and who travel throughout their territory during the crop season, personally inspecting crop areas, conferring with State and local authorities, private and commercial agencies, and others interested in crop-reporting work. Each agent supplements his own observation with reports from a corps of selected crop reporters in his territory, who report directly to him and are wholly independent of the regular crop reporters who report directly to the bureau.

In addition to the regular force of State field agents the bureau has a small force of crop specialists, one or more for each of the important special crops, such as cotton, tobacco, rice, and truck crops, possessing the same qualifications and performing the same duties as the field agents, but devoting their entire time to specializing on the particular crops to which they are assigned

and traveling throughout the entire region in which they are grown. These crop specialists also have selected lists of crop correspondents reporting directly to them.

Both the State field agents and the crop specialists are in the classified service and are appointed only upon certification by the Civil Service Commission after a rigid competitive examination. They are selected for their special training and qualifications for the work and, as they acquire knowledge and experience, will become recognized authorities in crop production in each State.

There are approximately 2,800 counties of agricultural importance in the United States. In each the department has a principal county reporter who maintains an organization of several assistants. These county reporters are selected with special reference to their qualifications and constitute an efficient branch of the crop-reporting service. They make the county the geographical unit of their reports, and, after obtaining data each month from their assistants and supplementing these with information obtained from their own observation and knowledge, report directly to the department at Washington.

In practically all of the townships and voting precincts of the United States in which farming operations are extensively carried on the department has "township" reporters who make their immediate neighborhood area with which they are personally familiar the geographical basis of reports, which they also send directly to the department each month. There are about 32,000 township reporters.

Finally, at the end of the growing season a large number of individual farmers and planters report on the results of their own individual farming operations during the year; valuable data are also secured from 30,000 mills and elevators.

Because of the specialized nature of the cotton crop the reports concerning it are handled separately from reports on all other crops. In addition to the regular estimates of the State agents, the cotton crop specialist, and the county and township reporters, the bureau obtains reports on acreage, yields, percentage ginned, etc., from many thousand special reporters who are intimately concerned in the crop, including practically all the ginners.

Table Showing the Scope of the Work Involved in the Preparation of the Several Crop Reports

[Key: (A) Acreage; (%a) acreage in per cent of last year; (b) number of breeding sows compared with last year; (c) condition; (d) losses from disease; (e) losses from exposure; (F) final estimates (acreage, production, value); (f) per cent of crops shipped out of county where grown; (h) number stock hogs compared with year ago; (l) cut for silos; (m) per cent of crop of merchantable quality; (n) number; (P) production; (%p) per cent of full crop produced; (q) quality; (r) acreage remaining after abandonment; (s) supplies on farms; (v) values; prices of products marked (v+) in January are asked each month; (w) weight per bushel — or fleece; (Y) yield per acre — or colony.]

Crop	Jan.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Cereals:											
Barley	v+	sf	..	..	Ac	c	sc	c	Pq	w	F
Buckwheat	v+	..	..	..	..	..	Ac	c	c	Pq	F
Corn	v+	sfm	..	..	..	Ac	c	c	c	sPql	F
Oats	v+	sf	..	..	Ac	c	sc	c	Pq	w	F
Rice	..	..	..	..	..	Ac	c	c	c	..	qF
Rye	v+	..	c	rc	c	c	APq	..	..	..	AcF
Wheat (all)	v+	sf	..	..	..	s	..	..	..	..	F
Wheat (spring)	..	..	..	..	Ac	c	c	c	Pq	w	F
Wheat (winter)	..	..	c	rc	c	c	Pq	..	..	w	AcF
Forage (grasses):											
Alfalfa, hay	v+	..	..	..	c	c	c	%p	..	..	..
Alfalfa, seed	v+	..	..	..	..	..	..	..	Y%p	..	..
Blue grass, seed	..	..	..	..	c	c	c	%p	..	..	..
Canadian peas	..	..	..	..	c	c	c	c	%p	..	..
Clover, hay	v+	..	..	..	%ac	c	Y%p	..	..	..	..
Clover seed	v+	..	..	..	..	..	..	%ac	c	Y%p	..
Cowpeas	..	..	..	c	c	c	c	c	c	%p	..
Hay (all)	v+	..	..	..	..	..	Ac	Pq	..	..	..
Hay (tame)	..	..	..	s	c	c	A	Pq	..	..	F
Hay (wild)	v+	..	..	..	..	..	A	Pq	..	..	..
Kafir corn	..	..	..	..	..	c	c	c	%p	Y%p	..
Meadows	..	..	..	c	..	..	..	..	..	..	..
Millet	..	..	..	..	..	c	c	c	%p	..	..
Pastures	..	c	c	c	c	c	c	c	c	..	..
Timothy, hay	v+	..	..	..	..	c	c	%p	..	..	..
Fruits:											
Apples	v+	..	..	..	c	c	c	c	c	%pq	f
Apricots, California	..	..	..	c	c	c	c	%p	..	..	..
Blackberries	..	..	..	..	c	c	%p	..	..	..	..
Cantaloupes	..	..	..	c	c	c	c	%p	..	..	..
Cranberries	..	..	..	..	..	..	..	c	c	Y%p	..
Grapefruit, Florida	v+	c	c	c	c	c	c	c	c	c	Y%pq
Grapes	..	..	..	..	..	c	cv	cv	cv	%pqv	v
Lemons, California	v+	c	c	c	c	c	c	c	c	c	Y%pq
Limes, Florida	v+	c	c	c	c	c	c	c	c	c	%pqq
Olives, California	..	..	..	..	c	c	c	c	c	c	%p
Oranges	v+	c	c	c	c	c	c	c	c	c	Y%pq
Peaches	..	..	c	c	c	cv	cv	%pqv	v	..	..
Pears	v	..	c	c	c	c	cv	cv	cv	%pqv	v
Pineapples, Florida	..	c	c	c	cv	cv	%pv	v	v	v	..

TABLE SHOWING THE SCOPE OF THE WORK INVOLVED IN THE PREPARATION OF THE SEVERAL CROP REPORTS (*continued*)

Crop	Jan.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Fruits (*continued*):											
Prunes, California	..	..	..	..	c	c	c	c	%p	..	..
Raspberries	..	..	..	..	c	c	%p	..	..	..	..
Strawberries	..	..	..	..	..	%p	..	..	..	..	..
Watermelons	..	..	..	c	c	c	c	%p	..	..	..
Vegetables:											
Beans (dry)	v+	..	..	..	..	c	c	c	%p	..	..
Beans (lima)	..	..	..	..	c	c	c	c	%p	..	..
Beans (velvet), Florida	..	..	..	c	c	c	c	c	c	c	%p
Cabbages	v+	c	c	..	c	c	c	c	Y%p	..	..
Cauliflower, California	..	c	c	%p	..	..	..	..	..	..	..
Celery, California	..	c	%p	..	..	..	..	..	..	..	..
Onions	v+	..	..	..	c	c	c	c	Y%p	..	..
Potatoes	v+	c	c	c	..	Ac	c	c	c	Pq	F
Sweet potatoes	v+	..	..	..	..	Ac	c	c	c	Pq	F
Tomatoes	..	c	c	c	..	cv	cv	cv	%pv	..	..
Miscellaneous:											
Almonds, California	..	..	..	c	c	c	c	c	c	%p	..
Broom corn	v+	..	..	..	..	c	c	c	Y%p	..	..
Cotton	v+	..	..	..	c	Ac	c	c	c	..	rP
Flaxseed	v+	..	..	..	..	Ac	c	c	c	Pq	F
Hemp	..	..	..	..	c	c	c	c	Y%p	..	..
Honey	v+	..	..	..	..	..	Y	..	..	..	..
Hops	v+	..	..	..	..	c	c	c	Yq	..	..
Peanuts	v+	..	..	..	..	c	c	c	c	Y%pq	..
Planting	..	..	..	%	..	..	..	..	..	..	..
Plowing	..	..	..	%	..	..	..	..	..	..	..
Sorghum	..	..	..	..	..	%ac	c	c	c	Y	..
Sugar beets	..	..	..	..	c	c	c	c	c	c	%aYp
Sugar cane	..	..	..	..	%ac	c	c	c	c	c	%p
Tobacco	..	..	..	..	..	Ac	c	c	c	Pq	F
Walnuts (English), California	..	..	..	..	c	c	c	c	cv	%pv	v
Wool	v+	..	..	..	..	w	..	..	..	%p	..
Live Stock:											
Horses	nv+	..	dc								
Mules	nv	..		..	..	..	..	..	..	..	..
Milch cows	nv+	..	..	..	..	..	..	..	..	..	..
Other cattle	nv+	..	..	..	..	..	..	..	..	..	..
All cattle	..	..	dec	..	..	..	..	..	..	..	..
Sheep	nv+	..	dec	..	..	..	..	..	..	..	..
Lambs	v+	..	de	..	..	..	..	..	..	..	..
Swine	nv+	..	dcb	..	..	..	..	hc	..	..	..
Honey bees, colonies	..	..	..	nc	..	..	..	..	..	..	..

NOTE. — Reports of prices are also obtained monthly for butter, eggs chickens, milk, veal calves, timothy seed, cottonseed, cottonseed meal, and bran; for soy beans in January, February, October, November, and December; for black walnuts, hickory nuts, pecans, and turkeys in January, October, November, and December; for turnips and pop corn in January, February, November, and December; for maple sugar and maple sirup in March, April, May, and June; for chestnuts in October, November, and December; and for cane sirup and sorghum sirup, in Florida, in December.

Transmission of Reports to Bureau by Correspondents

Previous to the preparation and issuance of the bureau's reports each month the correspondents of the several classes send their reports separately and independently to the department at Washington.

In order to prevent any possible access to reports which relate to speculative crops, and to render it absolutely impossible for premature information to be derived from them, all of the reports from the State field agents, as well as those from the crop specialists, are sent to the Secretary of Agriculture in specially prepared envelopes. By an arrangement with the postal authorities these envelopes are delivered to the Secretary of Agriculture in sealed mail pouches. These pouches are opened only by the Secretary or Assistant Secretary, and the reports, with seals unbroken, are immediately placed in a safe in the Secretary's office, where they remain sealed until the morning of the day on which the bureau report is issued, when they are delivered to the statistician by the Secretary or the Assistant Secretary. The combination for opening the safe in which such documents are kept is known only to the Secretary and the Assistant Secretary of Agriculture. Reports from field agents and crop specialists residing at points more than 500 miles from Washington are sent by telegraph, in cipher. The reports from the county correspondents, township correspondents, and other voluntary crop reporters are sent to the Chief of the Bureau of Crop Estimates by mail in sealed envelopes.

Preparation of Reports

The reports received by the department from the different classes of individual correspondents are tabulated and compiled and the figure for each separate State computed. After the reports from the different counties are tabulated, a true weighted figure for the State is secured by taking into consideration the relative value which the total acreage or production of each county in the State bears to the total acreage or production of the State. The weight figure showing the value of the county is applied to the acreage, yield per acre, or condition, whichever

it may be, and from the totals of the weights and the extensions a weighted average for the State is ascertained. The averages for speculative crops (corn, wheat, oats, and cotton) are determined by computers who do not know the particular State to which their figures relate.

The work of making the final crop estimates each month culminates at sessions of the crop reporting board, composed of five members, presided over by the statistician and chief of bureau as chairman, whose services are brought into requisition each crop-reporting day from among statisticians and officials of the bureau, and field agents and crop specialists who are called to Washington for the purpose.

The personnel of the board is changed each month. The meetings are held in the office of the statistician, which is kept locked during sessions, no one being allowed to enter or leave the room or the bureau, and all telephones being disconnected.

When the board has assembled, reports and telegrams regarding speculative crops from field agents and crop specialists, which have been placed unopened in a safe in the office of the Secretary of Agriculture, are delivered by the Secretary, opened, and tabulated; and the figures, by States, from the several classes of correspondents and agents relating to all crops dealt with are tabulated in convenient parallel columns; the board is thus provided with several separate estimates covering each State and each separate crop, made independently by the respective classes of correspondents and agents of the bureau, each reporting for a territory or geographical unit with which he is thoroughly familiar.

Abstracts of the weather condition reports in relation to the different crops, by States, are also prepared from the weekly bulletins of the Weather Bureau. With all these data before the board, each individual member computes independently, on a separate sheet or final computation slip, his own estimate of the acreage, condition, or yield of each crop, or of the number, condition, etc., of farm animals, for each State separately. These results are then compared and discussed by the board under the supervision of the chairman, and the final figures for each State are decided upon.

The estimates by States as finally determined by the board are weighted by acreage or other figures representing the relative importance of the crop in the respective States, the result for the United States being a true weighted average for each subject.

Method of Issuing Reports

Reports in relation to cotton, after being prepared by the crop-reporting board and personally approved by the Secretary of Agriculture, are issued on or about the first day of each month during the growing season, and reports relating to the principal farm crops and live stock about the seventh or eighth day of each month. In order that the information contained in these reports may be made available simultaneously throughout the entire United States, they are handed, at an announced hour on report days, to all applicants and to the Western Union Telegraph Co. and the Postal Telegraph-Cable Co., which have branch offices in the Department of Agriculture, for transmission to the exchanges and to the press. These companies have reserved their lines at the designated time, and forward immediately the figures of most interest. A multigraph statement, containing such estimates of condition or actual production, together with the corresponding estimates of former years for comparative purposes, is prepared and mailed immediately to newspaper publications.

The crop estimates for the State and for the United States as a whole are telegraphed immediately to the Weather Bureau station director of each State, in whose office copies are printed and mailed to all the local papers in the State, so that the crop estimates of the bureau are published throughout the United States within 24 hours of their issuance.

Promptly after the issuing of the report, it, together with other statistical information of value to the farmer and the country at large, is published in the *Agricultural Outlook*, a publication of the Bureau of Crop Estimates, under the authority of the Secretary of Agriculture. An edition of over 225,000 copies is distributed to the correspondents and other interested parties throughout the United States each month.

Acreage Estimates

For many years, in fact since the bureau was organized in 1862, it has been the practice to accept the estimates of acreage planted to different crops as reported by the Bureau of the Census every 10 years.[1] Then in the first year following the census the crop reporters of this bureau would estimate the acreage planted as a percentage of the acreage reported by the census for the preceding year; the second year following the census the acreage would be estimated as a percentage of the acreage estimated the preceding year, and so on until figures for the next census are available. Theoretically, if there is no bias or tendency to underestimate or overestimate on the part of crop reporters, the acreage estimates by this method for the tenth year after a census would agree with the acreage reported by the census for that year. A weak point in the system which has long been recognized is the fact that individual crop reports are not free from bias, and there appears to be a fairly uniform tendency to either overestimate or underestimate the acreage, the result being a cumulative error which in 10 years is apt to result in a wide discrepancy between the estimates of this bureau and the figures of the census. To illustrate, if the Bureau of the Census should report 10,000,000 acres planted to a given crop, and there should be a uniform tendency on the part of the crop reporters of this bureau to underestimate the acreage of this crop an average of 2 per cent annually, this bureau might estimate the acreage as 9,800,000 acres the first year after the census, as 9,604,000 acres the second year, as 9,412,000 acres the third year, and so on until the tenth year, when the bureau's estimate for the crop would be 8,170,000. If during the 10-year period there had actually been no change in the acreage planted to the particular crop in question, and the census should again report an acreage of 10,000,000, the result would be a manifest discrepancy of 1,830,000 acres between the figures of this bureau and those of the census. Further discrepancies would appear in the yield per acre and the total yield.

[1] Prior to 1880 the census did not show acreages of crops — merely production; hence in the earlier years the acreage basis was obtained by dividing the census report of total production by an estimated yield per acre.

At or near the close of harvest each year agents and crop reporters of the bureau estimate the yield per acre, in bushels, pounds, or tons, according to the nature of the product. The estimate of total production is readily obtained by multiplying the yield per acre thus obtained by the previously estimated total number of acres.

It will be observed that the method of estimating the yield per acre differs materially from the method of estimating the total acreage, the acreage estimate being based upon a percentage of the preceding year's acreage, thus carrying on from year to year any error made in any previous year; whereas the yield-per-acre estimate, being based upon the one year and not referring to any former year, is not affected by any error of a previous year. A constant yearly underestimate of, say, 2 per cent in the acreage will be magnified to a difference of about 10 per cent in 5 years and 20 per cent (approximately) in 10 years. A constant yearly underestimate of 2 per cent in the yield per acre will not be magnified in 5 or 10 years, but, on the other hand, in comparing one year's estimated yield with another the errors will be neutralized; that is, the effect would be the same, so far as comparative value is concerned, as though no error had occurred. In short, biased errors in acreage estimates by percentage grow from year to year; biased errors in yield-per-acre estimates neutralize each other.

The Bureau of the Census enumerates total acres and total production of crops; if yield per acre is wanted it is obtained by dividing the production by the acres. The Bureau of Crop Estimates obtains directly from its agents and correspondents estimates of acreage (as described) and yield per acre and arrives at the total production by multiplying acreage by yield per acre.

Notwithstanding the difference in methods of procedure, the estimates of yield per acre obtained by the Bureau of Crop Estimates in census years and the figures of yield per acre obtained by the census, with few exceptions, do not vary widely.

Live-Stock Estimates

Practically the same difficulty is encountered by this bureau in its estimates of the numbers of different classes of live stock, i. e., the probable cumulative error resulting from a uniform tendency to either underestimate or overestimate and the consequent application of an erroneous percentage to the census figure the first year and to an erroneous basis in each succeeding year until the next census. A further cause of divergence between the live-stock estimates of this bureau and the figures of the census, and between any two census years, results from taking the census or making the estimates at different seasons of the year. It can readily be seen that in the case of sheep and swine the estimates cannot agree unless made as of the same date, because of the normally wide fluctuations in numbers due to natural increase during a few months in spring and the large decrease due to slaughter in the case of swine, and also from exposure and other causes in the case of sheep during the winter months.

While the Bureau of Crop Estimates has in recent years taken cognizance of the tendency to bias on the part of its field force and has endeavored to make such allowance therefore as would correct the errors involved, besides checking its estimates against the returns of tax assessors in different States and such other reliable sources of information as are available, it has felt the need for a better method of estimating acreages and live stock between the census years.

Use of Rural Mail Carriers

As an experiment, and with the coöperation of the Post Office Department, an attempt was made in the winter months of 1913–14 to secure accurate data as to acreage planted and numbers of live stock in the State of Maryland and 15 counties in South Carolina by means of short, simple schedules left in mail boxes and collected by the rural mail carriers. In theory this plan should result in complete returns as accurate as a census, but in practice it was found that less than 40 per cent of the farmers would fill out the schedules. The experiment demonstrated that satisfactory results by this method cannot be secured without

(1) a personal canvass and actual enumeration by the rural mail carriers similar to that of the census enumerators; (2) legislation making it compulsory upon farmers to supply the information requested; or (3) a long campaign through the press and other agencies to educate the farmer into the idea of furnishing information of a statistical nature regarding their business, primarily for their own benefit and incidentally for the benefit of others.

Typical Farms for Estimating Acreage and Live Stock

The experiment in utilizing the services of rural mail carriers for making an actual enumeration of acreages and of live stock having proved inadequate and unsatisfactory, even as a basis for estimating, it was decided to establish a selected list of typical farmers in each county in the United States who will agree in advance to coöperate with the department to the extent of furnishing accurate statements of acreages and live stock on their farms for a series of years. These reports will establish a basis for comparison with the census figures and will enable the department to estimate with a high degree of accuracy the changes which take place annually between censuses. In future years it will be a simple matter to apply the rate of increase or decrease in acreages and live stock which is found to take place on the selected typical farms in each county to the total number of farms reported by the Bureau of the Census, and the results can be used to check the estimates prepared on the percentage basis under the present system. A much higher degree of accuracy will also be possible with census returns available every 5 years, as will be the case hereafter, instead of only once in 10 years as heretofore.

The " Normal " as a Basis of Condition Reports

Special consideration has been given for many years to the so-called " normal," representing a condition or yield of 100 per cent, in terms of which all the crop condition estimates of this bureau are expressed. An objection to the use of this term and what it represents, as a basis for crop reporting, arises from its apparent vagueness and the fact that the yield represented by it

is different for each locality and even for each farm, thus requiring explanation in order to be understood. The principal advantage of the term "normal" is psychological in that it is based on a fundamental conception which is fairly uniform and clear in the minds of all practical farmers, from whom over 99 per cent of the crop condition reports of this bureau are received.

But little observation and experience is required to demonstrate that the average farmer thinks of his crop as "crops" and not in mathematical terms of percentages or averages, although he can readily express the estimated yield of the crop in terms of bushels, pounds, or tons. When the farmer sows the seed in spring he knows just what the field ought to yield, and if the season is favorable he expects to harvest that yield. This expected yield is a "full crop," such as he has harvested in the past in favorable seasons. It is neither a maximum possible or even a bumper crop, which occurs only at rare intervals when conditions are exceedingly favorable, nor a medium or small crop grown under one or more adverse conditions. Neither is it an average crop, which rarely occurs because of the effect on the average of extremely low or extremely high yields in exceptional seasons. It is rather the typical crop represented by the average of a series of good crops, leaving out of consideration altogether the occasional bumper crop and the more or less frequent partial crop failure. This expected yield at planting time, the full crop that the farmer has in mind when he thinks of the yield he expects to harvest, or the typical crop represented by the average of good crops only, is the "normal," or standard adopted by this bureau for expressing condition during the growing season and yield at harvest time.

The observation is sometimes made, as a criticism of the use of the normal, that a normal crop is almost never shown in the reports of the bureau. A little reflection will show that a normal yield for an entire State or the United States is not to be expected except on rare occasions. Imagine the yields of 10 different farmers in widely scattered parts of the United States; by definition of the term normal as a "full crop," or expectation of yield at planting time, an individual will not secure a normal yield

every year, or even every two years. Suppose each individual secured a normal crop on the average every three years, by the law of probability the chance of all 10 farmers getting a normal crop in the same year is 1 to 30. If returns of individuals were published, many normals would be shown, but the frequency would be less in a county average, still less in a State average, and rare in a United States average.

The crop prospect is a subject of vital interest to farmers and, like the weather, it is a perennial topic of discussion during the crop season. Almost invariably farmers speak of the prospects as fine, good, fair, or poor, and they describe the crop as "full crop," "good crop," "average crop" (meaning less than a full crop but a little better than the real average), "three-fourths of a crop," or "one-half of a crop," or less frequently "75 per cent of a crop," "50 per cent of a crop," etc. In the South the cotton crop prospect is usually spoken of in terms of bales, as "three-fourths bale per acre," "one-half bale per acre," or "one-third bale per acre." Few farmers think of their crops in terms of exact mathematical averages or, in fact, know what the exact average really is, because very few of them keep accurate records or take the trouble to strike averages from them. It is equally true that farmers do not generally speak of crop conditions and crop prospects in terms of a normal, but when the farmer crop reporters are told that the normal is the same as their conception of a full crop, the crop which their farms ought to yield and are expected to yield in favorable seasons, and that this normal is represented by 100, they have no difficulty in clearly understanding what is meant by the normal or in expressing their estimates in percentages of normal.

Reports of crop condition expressed in percentage of normal may indicate in a general way the probable yield, but as they do not include the variations in acreage it would be impracticable to forecast total production accurately from condition estimates alone. Hence, to avoid errors in the interpretation of condition estimates by those who do not have the average figures before them, the bureau converts the condition estimates into quantitative estimates of yield per acre, which, applied to the estimated acreage of a given crop, indicate the probable total production.

The question is frequently asked why the crop estimates are not (1) based on the average crop (presumably the average for the past 5, 10, or 20 years), or (2) on the crop of the preceding year, or (3) simply estimated for the present year in terms of bushels, pounds, or tons.

The answer to the first proposition is that no "average crop" can properly be said to exist, or rather it would not correspond to any crop actually harvested, because the average for any given period is unduly influenced by the exceptionally low or high yields of abnormal seasons. In other words, the average is a fluctuating instead of a fixed standard. Furthermore, it would be exceedingly difficult to obtain satisfactory estimates of crop prospects based on average yields from farmer crop reporters, who constitute the bulk of the bureau's field force in reporting on crop conditions during the growing season. Farmers as a rule do not keep a record of average yields on their farms or for their communities. They do, of course, remember abnormally high or low yields, but they invariably leave such yields out of consideration when estimating crop prospects. If the average crop, say, for a period covering the last five years, were adopted as the standard, it would be necessary for the bureau to estimate the average condition for each month of the growing season, and the average yield for each year in each county and township in the United States (over 30,000) for each of the crops included in the estimates (50 or more), and to furnish each crop reporter with the average production of each crop in his territory for use in making up his monthly estimates during the year. This would entail an enormous amount of additional work, and the average would be unsatisfactory because the smaller the unit of territory the greater would be the fluctuation in the average or standard caused by crop failures or occasional bumper yields. A single illustration will suffice to make this point clear. Taking the corn crop of Kansas as an example, the average yield of corn per acre in the State of Kansas for each of 10 years, beginning with 1903, was as follows: 20.9, 27.7, 28.9, 22.1, 22, 19.9, 19, 14.5, 23, 3.2. The average for the 10 years is 20.1 bushels; the average for the last 5 years is 15.9 bushels; for the preceding 5 years 24.3 bushels.

On the other hand, the idea of a normal crop, or a full crop, was nearly constant, being 31.7 for the last 5 years, 31.5 for the preceding 5 years, and 31.6 for the 10 years.

The answer to the second proposition, namely, a comparison of this year's crop with the crop of the preceding year, is that while farmers remember fairly well the condition and yield of crops for the past year, they do not remember them with sufficient clearness or accuracy to be able to use them as a standard of comparison for this year. Furthermore, the crops of last year may have been abnormally high or low, and would therefore make a very poor basis of comparison. For instance, the yield of corn per acre in Kansas was 23 bushels in 1912, or 159 per cent of the yield per acre in 1911 (14.5 bushels). The yield in 1913, an abnormally dry season, was only 3.2 bushels per acre, which was 14 per cent of the yield in 1912. If the yield per acre of corn in Kansas for 1914 should be 21 bushels per acre, it would be 656 per cent of the yield of 1913. It is apparent, therefore, that the abnormally low yield of 1913 is a most unsatisfactory basis of comparison for the year 1914.

The third proposition, namely, the estimating of crops directly in terms of bushels, pounds, or tons, is sometimes advanced. The objection to this system is the difficulty that most people experience in estimating accurately, until near harvest, the number of bushels or pounds which an acre will yield, even though they may be good judges and have the field before them. Experience has demonstrated repeatedly that it is much easier to estimate proportions and differences in comparing one period with another, or the production of one year with the production of another year, or condition and prospective yield with some standard, such as a normal, than it is to estimate quantitatively what the condition or yield for a given area actually is at any given time. Anyone can demonstrate this principle to his own satisfaction while looking at a shelf partly filled with books or a glass jar partly filled with beans. The shelf or jar becomes in each case the standard or normal represented by 100 per cent. He will probably find that he can readily estimate that the shelf or jar is three-fourths or 75 per cent full, and while he may be able to guess within 25

per cent of the actual number of books, he may overestimate the actual number of beans in the jar more than 100 per cent. So with cereals or other crops. It is relatively easy for the crop reporter to estimate the prospects as 90 per cent of the normal or other standard, but he may have difficulty in estimating within 25 per cent of the actual prospects in terms of bushels. Of course, crop estimates stated simply as percentages of a normal or other standard would not mean much, for which reason, wherever practicable, such estimates are converted into numerical statements by the bureau and their equivalents in bushels, pounds, or tons are published in comparative statements showing the figures for the previous year and the 5 or 10 year average.

This whole subject of standards or bases for crop reports has been thoroughly and repeatedly considered, both in this country and abroad. On every occasion when the subject has been considered in this bureau the normal has seemed to possess more advantages and fewer disadvantages than any other standard. The Canadian Government has adopted as its basis of crop estimates the principle of the 10-year average. The 10-year average has also been adopted by the International Institute of Agriculture at Rome, and the Institute is constantly urging its adoption by the adhering countries. Great Britain still uses the 10-year average as the standard, which is fluctuating. Germany and a few other European countries use the numbers 1 to 5, inclusive, to represent the condition of excellent, good, fair, poor, or very poor. In France the same gradations of conditions are symbolized by 80 to 100, 60 to 80, 40 to 60, 20 to 40, and 1 to 20. The German system results in confusion because in Germany the number 1 represents the highest condition, while in Sweden it represents the lowest condition; besides, the terms excellent, good, fair, or poor are only descriptive and are open to interpretations which interested speculators may desire to place upon them.

Accuracy of Condition Reports

The quantitative interpretation by the Department of Agriculture of condition reports of principal crops, except cotton, was begun in 1911. A review of these interpretations, or forecasts,

shows that those made in June varied an average of 11.2 per cent from final yield estimates; those in July varied 9.6 per cent; in August 6.7 per cent; in September 4.3 per cent; in October 3.1 per cent. Generally forecasts made one and two months before the harvest inquiry are very close to the final estimates of yield. The above percentages do not reflect the accuracy of the work of estimating, but rather reflect the variableness of conditions affecting growing crops, which is shown by changes which take place after the dates to which the condition reports relate. The condition of a corn crop on August 1 may be normal with a forecast of 35 bushels per acre; but the crop may be practically ruined 10 days later by a devastating hot wind, and the final yield be but 2 or 3 bushels per acre. The forecasts are such figures that, based upon average conditions in past years, there is an even chance or probability that the final yield will be either above or below the figure forecast. A variation of 11.2 per cent from the June forecast does not necessarily indicate an error of 11.2 per cent in the forecast, but rather indicates an average subsequent change in condition of 11.2 per cent before harvest.

The forecasts made during the past three years, and final estimates of yield, are given below: —

	Forecast made in —					Final estimate
	June	July	August	September	October	
Corn (bushels):						
1911	....	25.5	22.6	23.6	23.8	23.9
1912	....	26.0	26.0	27.7	27.9	29.2
1913	....	27.8	25.0	22.0	22.2	23.1
Winter wheat (bushels):						
1911	15.3	14.6	....	....	....	14.8
1912	14.1	13.9	....	....	....	15.1
1913	15.9	15.6	....	....	....	16.5
Spring wheat (bushels):						
1911	13.7	11.8	10.1	9.8	....	9.4
1912	13.8	14.1	15.1	15.6	....	17.2
1913	13.5	11.7	12.5	13.0	....	13.0

	Forecast made in —					Final estimate
	June	July	August	September	October	
All wheat (bushels):						
1911	14.7	13.5	12.8	12.6	....	12.5
1912	14.0	14.0	15.1	15.4	....	15.9
1913	15.0	14.1	15.0	15.2	....	15.2
Oats (bushels):						
1911	27.7	23.2	23.2	23.9	....	24.4
1912	29.3	30.1	31.9	34.1	....	37.4
1913	28.8	26.9	26.8	27.8	....	29.2
Barley (bushels):						
1911	24.9	20.9	19.8	20.3	....	21.0
1912	25.2	25.6	26.7	27.6	....	29.7
1913	24.4	22.8	23.1	23.2	....	23.8
Rye (bushels):						
1911	16.1	15.5	....	....	....	15.6
1912	16.0	16.0	....	....	....	16.8
1913	16.5	16.1	....	....	....	16.2
Flaxseed (bushels):						
1911	....	8.6	7.6	7.7	8.1	7.0
1912	....	9.4	9.4	9.7	9.8	9.8
1913	....	8.7	8.3	8.4	8.7	7.8
Rice (bushels):						
1911	....	32.2	32.7	32.1	32.0	32.9
1912	....	31.7	31.9	32.7	33.4	34.7
1913	....	33.0	33.1	32.8	30.9	31.1
Potatoes (bushels):						
1911	....	81.7	71.5	74.2	79.7	80.9
1912	....	95.5	100.7	108.0	108.8	113.4
1913	....	93.1	92.0	88.1	86.7	90.4
Tobacco (pounds):						
1911	....	698.1	672.4	714.6	801.1	893.7
1912	....	844.9	820.6	817.1	816.0	785.5
1913	....	809.0	783.0	752.4	766.0	784.3
Hay (tons):						
1911	....	10.8	1.14	....	....	1.14
1912	....	1.40	1.49	....	....	1.47
1913	....	1.33	1.33	....	....	1.31
Buckwheat (bushels):						
1911	....	....	18.1	19.6	19.6	21.1
1912	....	....	19.3	21.3	21.4	22.9
1913	....	....	20.1	18.2	16.5	17.2

The preliminary estimates of the cotton crop in December each year are checked against the monthly and annual reports of production by the Bureau of the Census. The census reports, which are presumed to be the most accurate obtainable, indicate that the Bureau of Crop Estimates has overestimated the cotton crop 6 times and underestimated the crop 8 times in the past 14 years.

The following tabulation gives the annual estimates of the Department of Agriculture of the production of cotton, expressed in pounds of lint, the quantity as finally reported by the Bureau of the Census, and the percentage of overestimate or underestimate by the Department of Agriculture:—

NUMBER OF POUNDS OF LINT COTTON (NET WEIGHT) AS ESTIMATED IN DECEMBER, ANNUALLY, BY THE DEPARTMENT OF AGRICULTURE, AND AS SUBSEQUENTLY REPORTED BY THE BUREAU OF THE CENSUS, FOR EACH OF THE SEASONS 1900–01 TO 1913–14, INCLUSIVE, TOGETHER WITH THE PERCENTAGE OVER-ESTIMATED OR UNDERESTIMATED BY THE DEPARTMENT OF AGRICULTURE EACH SEASON.

Crop year	Pounds of cotton (000 omitted)		Over-estimated	Under-estimated
	Estimated by Department of Agriculture	Finally reported by Census Bureau		
			Per cent	*Per cent*
1900–1901	4,856,738	4,846,471	0.2	....
1901–2	4,529,954	4,550,950	....	0.5
1902–3	5,111,870	5,091,641	.4	....
1903–4	4,889,796	4,716,591	3.7	....
1904–5	6,157,064	6,426,698	....	4.2
1905–6	4,860,217	5,060,200	....	4.0
1906–7	6,001,726	6,354,110	....	5.5
1907–8	5,581,968	5,312,950	5.1	....
1908–9	6,182,970	6,336,070	....	2.4
1909–10	4,826,344	4,783,220	.9	....
1910–11	5,464,597	5,551,790	....	1.6
1911–12	7,121,713	7,506,430	....	5.1
1912–13	6,612,335	6,556,500	.9	....
1913–14	6,542,850	6,772,350	....	3.4
Total 1900–1914	78,740,142	79,865,971	....	1.4
Years of overestimate	31,879,051	31,307,373	1.8	....
Years of underestimate	46,861,091	48,558,598	....	3.5

As shown in the tabulation above, during the past 14 years the Department of Agriculture has overestimated the crop six times and underestimated it eight times. In years of overestimates the average error was 1.8 per cent; in those of underestimates the average error was 3.5 per cent; for the entire 14 years the average error was 2.8 per cent. Balancing the overestimates and underestimates shows, for the entire period, a net underestimate of only 1.4 per cent.

IV. Current Sources of Information in Produce Markets [1]

By Bruce D. Mudgett

Current information [2] dealing with the cotton market may be divided into two classes, based on the point of origin of the data, viz., (1) information concerning production, acreage and condition; and (2) statistics of current prices. The one must emanate necessarily from the area of production; for the other the only source is the exchanges. Cotton, like wheat, is peculiar in this respect that there has developed a most extensive system of trading in futures, and the middlemen on whose shoulders falls the risk of this system find it an economic necessity to discount pending conditions of supply and demand so as to shape their affairs to conform with a season's average condition. Mr. Henry G. Hester, secretary of the New Orleans Cotton Exchange, famous for his cotton reports, speaking of the need of these reports and the amount of dependence that can be placed upon them, says: "Reports of this kind are valuable as indications of the trend of supply and demand, and their contents exert more or less influence as statements of facts bearing upon the basic causes of price fluctuations. All other matters, such as wars and rumors of wars, panics, dear and cheap money, etc., etc., by reason of

[1] *The Annals of the American Academy of Political and Social Science*, vol. XXXVIII, No. 2, pp. 104–125. Reprinted by permission of *The Annals of the American Academy of Political and Social Science.*

[2] Only the most important sources of market news could be enumerated for each of the leading markets, and where criticisms have been offered, they have in nearly every case been given to represent the judgments of brokers and dealers, directly interested in the market, as obtained by personal interview or correspondence.

their bearing upon either the volume of supplies or the extent of demand for an article are collateral. Upon reliable statements of facts the world bases its opinions; these coupled with collateral conditions are the sources of deductions or forecasts of the possible or probable course of future values. To the extent of the reliability of statements of facts, or perhaps it would be more correct to say the amount of confidence reposed in such statements, is the price of an article more or less governed. The fear of the effect of any cause upon the possible supply or possible demand is proven to be more or less grounded by the actual facts as they occur, and while such fears may exert a temporary influence on values, the permanency of such influence is determined only through information concerning actualities."

The extensive area over which cotton is grown is the explanation of the large and complicated organizations which are engaged in reporting on production, condition and acreage of cotton. Greatest of all among these organizations is the United States Government. That the government crop reports have been subjected to just criticism in the past is undoubted. It is just as true that the cause of that criticism has been removed, and that the greatest degree of care is used in compiling and issuing the reports so as not to permit them to become prematurely available to unscrupulous manipulators. Nevertheless there are today still a great many brokers who maintain that all persons legitimately concerned in the distribution of the cotton crop would be better off if there were no crop reports issued. A favorite criticism leveled at the reports is that they are, and in their nature can be, nothing more than a guess by a government board; that both weather and acreage reports are used by manipulators and plungers to influence prices, thereby causing more and greater price fluctuations, and producing the very thing they were intended to prevent. Some brokers go to the extent of saying that the trade as a whole would be better off were no reports of any kind ever published. Upon analysis the situation appears to be a struggle between the interests most concerned in the "spot" markets and those interested in the "future" markets. The merchant dealing in the spot market is interested in his com-

mission and therefore is interested in as high a price for the product as he can get. In this he is supported by the producer. The dealer in the future market is the one who makes possible hedging operations on the part of manufacturers and the latter are interested in getting cotton at rock bottom prices. Between these two range the speculator and the manipulator ready to take advantage of a change of price in either direction. It is probable that the time will never come when all of such diverse interests can be wholly satisfied. In the meantime the government crop reports will continue to be published and their publication will have the loyal support of at least a large and influential minority of those interested.

The government reports are of three kinds: (1) the Weather Bureau reports; (2) reports of the Census Bureau on acreage and on cotton ginned; and (3) reports of the Department of Agriculture published in the *Crop Reporter*. The Weather Bureau reports are issued weekly and, as the name indicates, afford an opportunity of getting a line on weather conditions in the regions of the growing crop. The Census Bureau compiles reports of cotton ginned from statements received by it from the gins in active operation.

An unusual example of the accuracy with which these ginning reports measure the cotton crop was given last year (crop year of 1909–10). The Census Bureau had reported 10,386,000 bales of cotton ginned for the year. When Secretary Hester's report on the crop appeared in September it gave the actual growth for 1909–10 as 10,389,000 bales, a difference of only 3,000 bales. Needless to say that, while they usually correspond closely, they do not often produce a result like the above. The reports of cotton ginned also give the bureau an opportunity to get a line on the acreage.

Every five years a census is taken of the acreage. This acreage estimate is available to, and is used by, the Department of Agriculture. The first Census Bureau report, issued in June, gives estimated acreage as of May 25th. Thereafter, twice monthly, the bureau reports on the amount ginned. In March the total quantity ginned is reported. The Department of Agri-

culture through the crop reporting board makes six reports yearly on cotton. The first, issued on June 2d, reports the acreage and condition of the crop on May 25th, by states. Thereafter, in July, August, September and October, the condition of cotton is reported for the twenty-fifth of the month previous. The last report, issued about December 10th, publishes the estimate of the total production of cotton by states for the year.

Private reports on cotton fall heir to much the same criticism that is directed against the government reports. Among the total number will be found many which are little more than guesswork, and in which no credence can be placed. But, on the other hand, some of the private reports are prepared with the utmost care that large and costly organizations can give and deserve the confidence reposed in them.

A great many trade newspapers collect their own cotton statistics. Among these the reports of the *New York Journal of Commerce* are probably most widely known. They are collected by means of a large corps of correspondents located all over the cotton states, who send in their reports by letter or by wire to headquarters. The methods of the *Journal* are molded very much after those of the Department of Agriculture in the preparation of its crop reports. Much the same methods are followed by the *New York Commercial*. It publishes currently the usual statistics, but in addition issues four special crop editions during the season, often anticipating the government estimates by days and coming remarkably close to the figures of the latter. These special editions refer to "acreage planted," "prospective yield," "conditions" in September, and "total crop" early in December.

There are a number of newspapers in the South which report on the growing cotton crop, some of them for the crop as a whole, some of them confining their attention more to local conditions. The *New Orleans Times-Democrat* maintains correspondents in every section of the cotton belt and through them obtains and publishes comprehensive reports and a summary. In December, a few days prior to the publication of the government's estimate, the *Times-Democrat* prints its estimate of the season's

growth, and in years past this result has borne a very close correspondence with the actual figures appearing later.

Among individuals and firms publishing private reports on cotton, the best known are Henry G. Hester, secretary of the New Orleans Cotton Exchange; Oscar K. Lyle, of the firm of S. B. Chapin & Co., New York, and the Mercantile Cotton Crop Reporting Corporation, New York, which latter organization publish the reports formerly issued by Mr. Theodore H. Price. Secretary Hester's report is an annual one, coming out on September 1st and treating of the cotton crop to the close of August. Ordinarily, annual reports are looked upon as of historical importance only, but this report, because of its exhaustive nature and because of the confidence reposed in it, is eagerly watched for and undoubtedly exercises marked influence on the market. Secretary Hester's data are obtained from transportation companies, manufacturers, exchanges, boards of trade and expert correspondents on both sides of the Atlantic. Much of the detailed data obtained from manufacturers, railroad, etc., is of a confidential nature, but as he himself says, "Once it became known that the effort of the statistician was to arrive at correct aggregates and not to make public the affairs of specific concerns there has been little or no hesitancy in the furnishing of details." His report covers an analysis of the sources of supply with a history of the year's crop compared with previous years; the distribution of the crop to American mills both North and South, the overland movement and exports; and detailed stocks on hand.

In the case of Oscar K. Lyle's crop observations no blank forms are used, making a description of his methods very difficult. His results, however, are among those which are accepted as authoritative estimates.

The method used by the Mercantile Cotton Crop Reporting Corporation for obtaining their data is that noted in several previous instances, namely, the use of a great number of picked correspondents located in the cotton producing area. A postal is addressed to each one of these asking for estimates. In compiling this data a system of weighting is used, and it certainly contributes to a result more scientifically accurate than could a simple

arithmetic average of all the replies received. The county is the basis on which the results are tabulated. For each State a blank form is used, giving the yield of cotton for each county for three years past. The average of these three years is then computed; another column giving the percentage which the average for the county is of the total average crop for the three years. This column of percentages, then, gives the relative weight that the returns of each county are going to bear in making up the total for the State. [Table omitted.] Having obtained a figure for each State, these are again weighed for the final or United States result. Florida would be credited with one per cent, while Texas would have twenty-eight per cent. If estimates of the cotton crop are valuable, then the scientific method used above for arriving at a correct estimate is to be encouraged.

Opposed to this way of arriving at results will be found many to which the application of the term scientific would be a travesty. For instance, among doubtful methods of arriving at results the following examples might be cited: Inquiries are sent to dealers, buyers, farmers, etc., asking the simple question, "How much cotton will your county raise this year?" To the sum of the results thus received seven and one-half per cent is added, based on the observations that these correspondents generally underestimate the crop by that amount. This latter result is made the basis of a published estimate on the size of the crop. Many reports will be found which are based on no more trustworthy methods, and their existence justifies the suggestion that a careful description of method is due from any organization which issues reports to those who receive reports and base their operations on them. More diligence in this matter would mean less opportunity for manipulating the market.

In addition to the statistics thus far discussed concerning the cotton crop, brokers, producers and manufacturers are interested in current prices on the exchanges. This subject needs only a mention here, for each exchange individually compiles its own data, and by means of the ticker, telegraph and cable, and later the newspapers, this information is immediately disseminated to all interested parties.

Sources of Information in the Cereal Markets

Current information in the cereal markets is sought more eagerly than any other data in the produce markets, owing to the commanding importance which grain occupies. The system of trading in futures is greater in wheat even than it is in cotton, and just in proportion as it is greater there is greater demand for data as to current happenings.

It was to forecast the probable wheat crop that the government crop reports were first undertaken. From a small beginning they have grown in scope until today they cover almost everything grown in the United States that can be considered of commercial importance. Those parts of the reports dealing with the cereal crops which are traded in on exchanges are as follows: The March report gives the stocks of grain in farmers' hands; the distribution and consumption of corn, wheat and oats; and the average natural weight of wheat and oats. The April schedule, the first which gives condition reports, deals with the condition of winter wheat and rye. In May further reports are made upon the condition of winter wheat, rye, meadow lands and spring pasture. It also covers the portion of the original acreage of winter wheat that has been, or will for any reason have to be, abandoned. In June the acreage of all the important crops is reported on, chief among which is spring wheat. The condition of wheat, oats, barley, rye, clover and spring pasture is dealt with. The July schedule gives the acreage planted to corn; the stocks of wheat in farmers' hands; and the condition figures as before. Condition figures are reported for all crops up to September, when most of the smaller cereals are harvested. The condition of corn is reported on in October, and in the annual report for December the condition of winter wheat and rye planted for the following year's crop is dealt with. In addition to these data, the estimated average yield of winter wheat and the stocks of oats in farmers' hands are dealt with in August; the average yield and quality of spring wheat, barley, oats and rye in October; and the average yield per acre of corn in November. The annual report of the crop reporting board comes out in December, when all crops are

harvested and it is possible to obtain trustworthy estimates of the total crops. The production and prices of all the principal crops are dealt with in this schedule, together with the acreage of winter wheat and rye sown for the crop of the following year. The government's weekly weather reports are watched in the grain markets equally as closely as in cotton. In fact, some brokers will go so far as to say that a careful observance of weather conditions throughout the producing area will enable them to anticipate very closely the result of a coming crop report.

Aside from the government reports there are three agencies for securing news in the grain markets. They are (1) the grain exchanges and allied organizations; (2) large commission and brokerage firms, which make a canvass by correspondence; and (3) the private crop expert, the latter analogous to those already noted in the cotton market.

The grain exchanges annually spend enormous sums of money in compiling statistics of their own dealings. Nearly every exchange maintains a committee whose duty this shall be. The practice of the Philadelphia Commercial Exchange is typical. Its by-laws state that "The committee on information and statistics shall have supervision of the library of the exchange, and all matters pertaining thereto. . . . It shall, unless otherwise directed, have charge of newspapers, market reports, telegraphic and statistical information for the use of the exchange; and it shall be the duty of the said committee to organize plans for obtaining regularly, and at the earliest moment, such reliable information as may affect the value of articles dealt in by the members of the exchange."

The Philadelphia Exchange publishes each day a record of stocks held in elevators, vessels or cars loaded, and daily receipts and shipments. [A reduced facsimile of one of their daily reports is omitted.] Some of the exchanges go further and attempt to compile summaries. The Chicago Board of Trade, for instance, compiles figures of visible supplies of grain. But in this immediate connection the work that is best known and has most general acceptance throughout the country is that of *Bradstreet's Trade Review*. Bradstreet's collects the figures of stock of

grain on hand at the grain supply centers by means of agents and the use of the telegraph, and the total is published in the journal of that name. Visible supply figures are also published weekly by *Dun's Review*.

The greatest organization of all, either in this country or abroad, dealing with the grain exchanges as a whole is Broomhall's Agency. Broomhall's Agency has become the official representative of practically every important grain exchange in the world. Its method of operation is well described by Mr. G. P. Broomhall, the American representative, in a letter to the writer: "We have no regular forms which we send to our correspondents, but our agents send us advices, some daily, others weekly, either by mail or wire and also by cable. We have, for instance, about three hundred agents and correspondents scattered all through the important grain-producing countries, and any change in weather conditions, say in Russia or Argentine, is at once cabled to our Liverpool office, from which point it is again disseminated, in America, for instance, by this office" [the New York office] "to private subscribers here at New York, and they in turn wire the information over their private wires to Chicago and the far West. We are the foreign correspondents for the Chicago Board of Trade, and since January 1st this year [1911] are supplying the New York Produce Exchange with all their foreign information. The Buenos Ayres Grain Exchange also receives our foreign grain service, and also the Liverpool grain exchanges.

"All the largest exchanges in the world which handle grain use our foreign cabled grain service. We have agents on all these markets and through them we obtain the official prices posted on them, and they are in turn sent to Liverpool and again redistributed to other exchanges. Statistical information, such as exports, receipts, shipments, are also gathered by our agents and sent to Liverpool, who in turn have them tabulated and sent through the various countries. For instance, each Saturday afternoon I personally compile the shipments of wheat, corn and flour, that is, the amount of grain shipped from the different ports in this country for the week. We have agents at all the ports on the Atlantic and Pacific seaboard and they send me in by mail

and wire the amount of grain shipped for the week, and after condensing same I cable this information to my Liverpool office, and they, after receiving the returns from our agents in Russia, Argentine, India, Australia and any other exporting countries, are able by this to compile the total amount of wheat shipped for the week from all countries. . . . Our head office in Liverpool is the center to which all information is mailed, wired and cabled, and they in turn through the different exchanges are able to have the information made public all through the world." Broomhall's *Corn Trade News* is the official paper of this agency, a special edition of which is published in New York. Prices are sent from New York to Liverpool and posted on the exchange board within six minutes, and direct communication from New York to Argentine is accomplished within fifteen minutes.

In addition to the methods just described for collecting and compiling data, many of the larger grain commission and brokerage houses, such as Finley Barrell & Co., Chicago; Logan & Bryan, New York; Bartlett Frazier Company, New York; and S. B. Chapin & Co., New York, make a practice of canvassing the intelligent opinion of men located in the grain belt for the purpose of estimating the conditions of the grain, the acreage, etc. As an example, Finley Barrell & Co. recently mailed to some five thousand individual correspondents postal cards having the following questions concerning the corn crop:

Has corn crop turned out better or poorer than expected ?
Are husking returns larger or smaller than expected ?
What is the present condition of corn ?
Are farmers satisfied with present prices ?
Have they sold new corn freely ?
Will movement to market be free ?
How soon will it commence ?

A great number of these correspondents are in daily communication with their firms and are able to inform the latter of any circumstance of sufficient importance to justify a special investigation. In fact, Mr. S. S. Daniels, editor of the market reports of the Philadelphia Commercial Exchange, is authority for the statement that these reports coming in daily over cables, wires and tickers are the greatest general factor influencing prices.

The private crop experts are usually in the employ of, or represent, some large firm or commission merchants. Here as elsewhere it will be found that there are both good and bad. Numbers of so-called crop experts publish misleading crop reports in order to influence the market in the interest of speculators. But there are a number — one broker puts it at less than one and one-half dozen — of genuine crop experts, men of mature judgment whose business it is to give disinterested and impartial advice on the growing crops and whose opinions can be depended upon to represent the facts as they know them. Foremost among such men in this country are Mr. John M. Inglis, with Logan & Bryan, New York; Mr. B. W. Snow, of Bartlett Frazier Company, New York; Mr. Oscar K. Lyle, of S. B. Chapin & Co., New York; and Mr. George M. Le Count, with Finley Barrell & Co., Chicago. Representatives of any of these firms can usually be found on any important grain exchange.

These different men use different methods. The method of Mr. Le Count, for instance, is that of direct observation, going into and through the grain growing sections of the country and minutely examining the growing crops. Snow's reports, on the other hand, are the result of an organization almost as complicated as and modeled upon the government crop reporting service. Needless to say, these men, while classified together here, perform functions differing the one from the other.

The Coffee Market

The coffee market, like the grain market, looks to the exchanges for its current information. The production of coffee is localized as is probably no other commodity sold today by the exchange method. By far the largest part of the world's supply is grown in the State of Sao Paulo, Brazil. A small portion comes from the East Indies. The exchanges which are instrumental in fixing the prices of coffee are New York, Havre, Bremen and Hamburg. There are some private reports on coffee, but the superintendent of the New York Coffee Exchange is authority for the statement that with one exception they have no influence on the market. That report is the one issued by Messrs. Willet and Gray, of New York.

The great source of information in the United States on the coffee market is the New York Coffee Exchange. It publishes daily, monthly and annual reports; its figures are accepted as accurate throughout the world, and its reports are looked forward to with great interest by the trade. The statistical work of this exchange consists in collecting and compiling daily detailed information as to the prices of coffee on its own floor, at Havre, Hamburg and Rio de Janeiro; stocks on hand with their location; daily and weekly receipts and deliveries from all important warehouses of the world; coffee afloat, with source of origin and destination; and, lastly, reports on weather and temperature in the regions of coffee production. This information furnishes a complete report of the daily condition of the growing crop, the location and the movement of stocks on hand and the prices ruling on the important exchanges.

These daily reports are further condensed into a *monthly summary* of the figures enumerated above. The most important item of the monthly report is the table of the world's visible supply, and it is looked forward to each month with great interest. The visible supply figures are also compiled by two European organizations, viz., Messrs. Duuring & Zoon, of Rotterdam, and Mr. E. Laneuville, of Havre. The three separate totals show a very small difference.

The *Annual Supplement* of coffee exchange report summarizes in more condensed form the reports already noted and is of historical value principally. It serves, of course, to afford a quick comparison for a series of years as regards the total yield, the movement of the crop to points of consumption, and the comparative prices.

Metal Statistics

Information dealing with the metal market may be grouped under three heads, viz., (1) Sources of current statistics; (2) trade papers publishing current information; and (3) annual statistical publications. The following are the important ones: —

1. Sources of Current Statistics

A. United States Statistics:

American Iron and Steel Association, 261 S. 4th St., Philadelphia.
Copper Producers' Association, No. 1 Liberty St., New York.
Horace J. Stevens, ed., *The Copper Handbook*, Houghton, Mich.
Iron Trade Review, Cleveland, O.
Engineering and Mining Journal, New York.
United States Steel Corporation, Monthly Report of unfilled orders.
Custom House returns.

B. English and Foreign Statistics:

Julius Matton, 25 Rood Lane, London.
Henry Merton & Co., Ltd., London.
Vivian, Younger & Bond, London.

2. Trade Papers Publishing Current Information

Journal of Commerce and Commercial Bulletin, New York.
Iron and Coal Trades Review, London.
Iron Trade Review, Cleveland.
Iron Age, New York.
Mineral Industry, New York.
Engineering and Mining Journal, New York.
American Metal Market and Daily Iron and Steel Report. Published by the American Metal Market Co., 81 Fulton St., New York.
The Steel and Metal Digest (monthly). Published by the American Metal Market Co., 81 Fulton St., New York.
Bulletin of the American Iron and Steel Association, 261 S. 4th St., Philadelphia.

3. Annual Statistical Publications

Statistical Report of the American Iron and Steel Association, 261 S. 4th St., Philadelphia.
Metal Statistics, published by the American Metal Market Co., 81 Fulton St., New York.
Publication of the United States Geological Survey.
Commerce and Navigation of the United States, published by the Bureau of Statistics, Washington, D. C.
The Copper Handbook, published by Horace J. Stevens, Houghton, Mich.
Comparative Statistics of Lead, Copper, Spelter, Tin, Aluminum, Nickel, Quicksilver and Silver, compiled by the Metalsgesellschaft, the Metallurgische-Gesellschaft A.-G. and the Berg and Metalbank Aktiengesellschaft, Frankfurt-am-Main, Germany.
Directory of Iron and Steel Works in the United States, published by the American Iron and Steel Association.

This classification is made on the basis of nearness to the source whence the statistics originate both in time and place, the intention being to show as nearly as possible in all cases the original source from which the information is compiled, the channels by which it first reaches the general public, and then the annual volumes into which it finally finds its way and is permanently preserved.

The pioneer collecting agency for iron and steel statistics in the United States is the American Iron and Steel Association. Its statistical work relates mainly to the operation of all the iron and steel works of the United States, covering the production of the blast furnaces, rolling mills and steel works. So thoroughly does this organization do its work and in such confidence is it held by the trade that its data are accepted everywhere as authoritative. Its inquiries are sent to each individual manufacturer with requests for his own production. These returns are then summarized by districts, states and for the whole country. Much of the success of the association in obtaining data is due to its method of disclosing to no person the results for individual establishments. It publishes only the summaries. It sends out regular blank forms of a most comprehensive nature on which returns are made.

The *Iron Trade Review*, of Cleveland, a trade paper, collects from the mines of the Lakes Region their annual output of iron ore. While this is an annual publication, it is the only publication of its kind, and is looked forward to with great interest. It is republished in every important paper which reports on the metal markets.

What is done for iron and steel by the two organizations just noted is done in much the same manner for copper by two other organizations, viz., the Copper Producers' Association, of No. 1 Liberty Street, New York City, and Horace J. Stevens, editor of *The Copper Handbook*, Houghton, Michigan. The former is an association created and supported by about a dozen copper producing companies. And since these companies control the entire output, the production of copper is concentrated in a way that makes the gathering of data a simple matter. The Copper Pro-

ducers' Association has to deal with these few companies only. The reports are published monthly and deal exclusively with copper in marketable condition.

The best available source of statistics of mine production and of general information concerning copper and copper mining companies is that published by Horace J. Stevens in his annual *Copper Handbook*. In an extended letter to the writer, Mr. Stevens explains his method of collecting statistics and the importance of this subject justifies a reproduction in substance of his statement. With an annual request which he sends to mine owners he incloses a blank question sheet of a most exhaustive nature. This request goes to the ten thousand and more companies that are described in the *Handbook* and also to several thousand others who are not there included. In addition to these he utilizes other sources of information, as follows: Different governments of the world, through the proper departments, are requested to send official reports and other information not published but on file. All reports of mining companies are kept on file, as are also the prospectii of new companies. The services of a clipping bureau are utilized and a clipping bureau is maintained in his own office. One of his most valuable sources of information comes from his correspondence with mining engineers throughout the world.

Of first hand material two other sources must still be noted. The United States Steel Corporation now publishes a monthly report of its unfilled orders, and, due to its commanding position in the iron and steel business, this report is taken as indicative of the current condition of that industry. The report is looked forward to with great interest by brokers. The custom house furnishes currently to the trade the figures of imports and exports of metals, which later come out in the monthly and annual summaries. For English and foreign data there are three firms in London whose names are well known. No more than a mere mention of them is necessary here. They are Julius Matton, 25 Rood Lane; Henry R. Merton & Co., Limited, and Vivian, Younger & Bond. Their statistics of production and prices appear in the weekly editions of the *Iron and Coal Trades Review*

(London), and they are credited with a large part of the foreign statistics in the principal annual publications.

The second step in the distribution of this enormous mass of information is its publication by the trade papers. A detailed description of the reports of each of these journals is not necessary. The general objection that can be directed at most of them is that they are first technical journals, dealing with the mechanical side of mining and are only secondarily trade journals, publishing market news. The result of this is that their market reports are in many, if not most, cases meager in the extreme. Some of them, as, for instance, the *Iron Trade Review* and the *Engineering and Mining Journal* are important more because of the original material they compile than for their market reports. The *New York Journal of Commerce* is a model among the trade newspapers in this country. Its reports are full, are well classified and are not too much intermingled with "opinions." The *Iron and Coal Trades Review* (London) is also a model trade paper. Its weekly edition has separate divisions devoted to each of the important metal markets, beginning with a concise statement of the condition of the market, followed with a small and concise table of statistics comprising prices, production, etc. A large part of the value of its reports is due to the arrangement of the material in such a way that the substance can be quickly grasped without the necessity of disentangling it from a mass of unimportant data. The pioneer effort in the way of a daily paper devoted exclusively to the metal markets belongs to the American Metal Market Company. Its daily publication, the *American Metal Market and Daily Iron and Steel Report*, today publishes the best reports on production, prices and news of the metal trades, and it bids fair to become the sort of paper that is needed. The monthly publication of the same organization, *The Steel and Metal Digest*, presents the same data in a somewhat less detailed and more summarized form monthly. The American Iron and Steel Association issues a monthly bulletin dealing with the statistics it has compiled. Practically all the daily newspapers in the large cities publish daily reports on the metal markets. Most of these leave much to be desired. They give only a fleeting

impression of the market and are hardly trustworthy for one whose interest demands definite and detailed facts.

The work of the annual publications consists in collecting the information already enumerated and putting it in permanent form. Foremost among these is the *Annual Statistical Report of the American Iron and Steel Association*, which embodies the yearly results of the work of the association. The *Directory of Iron and Steel Works*, published, or revised, every three or four years by the same organization, is the only publication of its kind in the United States and is an invaluable work. *Metal Statistics*, published by the American Metal Market Company, is a comparatively recent publication, the fourth edition appearing in 1911. It is somewhat smaller and more condensed than the one first enumerated and presents in a concise handy pocket volume the important data. Its statistics are taken from the compilation of the Iron and Steel Association. *The Copper Handbook*, edited and published by Horace J. Stevens, is the best and practically the only volume dealing exhaustively with copper. The United States Government furnishes annual figures which cannot be obtained elsewhere. In the annual reports of the United States Geological Survey are to be found figures of the production and consumption of metals in the United States, and the annual volume on *Commerce and Navigation of the United States*, published by the Bureau of Statistics, furnishes figures of imports and exports of metals. Last to be noted is the most exhaustive publication of all dealing with metals, viz., *Comparative Statistics of Lead, Copper, Spelter, Tin, Aluminum, Nickel, Quicksilver and Silver*, published at Frankfurt-am-Main, Germany. This is a compilation by the Metalsgesellschaft, the Metallurgische-Gesellschaft A.-G. and the Berg and Metalbank Aktiengesellschaft, the sources of its statistics being in many instances the organizations already noted, but they are collected here in an exhaustive way nowhere else to be found. The possession of this compilation is indispensable to one who has large interests in the metal markets.

CHAPTER III

SALES AND ADVERTISING STATISTICS

Introduction

In retail stores, in wholesale houses, and in the sales and advertising departments of manufacturing establishments, whether large or small, statistical records are essential to intelligent management. The selections which are reprinted in this section illustrate the chief applications of statistics to the management of sales and advertising departments of manufacturing companies and to the administration of mercantile businesses. For convenience the subject is subdivided into four parts — (1) market analysis, (2) sales reports and records, (3) advertising statistics, and (4) statistics used in retail stores — all of which are closely related in principle. Since market analysis requires the use of both external and internal statistics, that subject is taken up first.

Market Analysis

In order to determine to which particular class of customers his sales campaign should be directed, a manufacturer finds it necessary to study his market carefully under present conditions of keen competition. Blunderbuss methods are wasteful; hence they are becoming antiquated. The demand for any article varies according to purchasing power, living conditions, occupations, racial characteristics, climatic conditions, and numerous other influences affecting the different classes of consumers. The object of market analysis is to determine which class or classes of consumers constitute the potential market for the product, to ascertain where that class is located, and to find out what channels of distribution are most readily available for reaching them. In making such an analysis statistics are serviceable.

There are few, if any, commodities for which equal per capita sales may be expected in all sections of the market, provided the

market is more than local in its scope. In each district there are numerous classes of consumers with widely different tastes and desires, and the relative proportions of these classes in different districts always vary. In New York City, for example, the population of the metropolitan district in 1910 was 6,475,000. In the same year the population of the Cleveland metropolitan district was 613,000. From these figures it cannot be assumed that the New York market for any particular article is potentially ten times as great as that of Cleveland. New York represents the extremes of wealth and poverty. Fifth Avenue and the Lower East Side are at opposite ends of the economic scale. Their wants and their purchasing power are wholly unlike and each differs from the large middle-class strata. In Cleveland the relative proportions of these several classes, with their numerous gradations of purchasing power and of wants, are not the same as in New York. The population of Cleveland, furthermore, differs in its composite parts from that of Cincinnati or other cities, and these differences in the make-up of the population affect potential demand. Another line of demarcation is between urban and rural districts. Because of these diversities a reliable estimate of potential demand can seldom be made upon a gross per capita basis.

In analyzing the market for some products, conditions other than those of a strictly personal nature must be taken into account. A manufacturer of electric flat-irons, for example, in analyzing his market found that in one city of 300,000 population 25,000 families were supplied with central station electric current. Thus there were 25,000 possible customers in that city. In another city of approximately the same size only 3,000 families were supplied with electric current; hence the potential market in this second city was much smaller.

For some products the market is clearly defined; in such cases the market is easily analyzed by the manufacturer. The manufacturer of machine tools, for example, knows that his product can be sold only to machine shops and engineering works and his task is to learn all the establishments existing and planned for in the territory that he wishes to cover with his sales organization.

The leather tanner can expect to sell his product in quantity only to shoe manufacturers and others for whom leather is a crude material. In order to obtain a basis for his sales estimates, the tanner's task is likewise to secure the names and addresses of his possible customers and to find out the volume of their businesses. A similar situation confronts other producers of equipment and materials that are sold to manufacturers. Certain manufacturers of specialties sold to other classes of customers can encompass their market in a list that does not assume excessive proportions; a manufacturer of surgical appliances, for example, can readily obtain and utilize a practically complete list of possible customers. For the great mass of goods sold at retail, however, and for general supplies sold to manufacturers, the market is of a different type and potential demand is much less easily estimated.

Several examples of methods that have been used in market analysis are given in the selections reprinted in this chapter. There are many other statistics applicable to market analyses for other sorts of commodities and still other statistics are occasionally used which are, however, of questionable utility. This latter class deserves examination.

In undertaking an analysis of the market for an article which is sold over a wide territory and for which a market index can be selected only with difficulty, too much attention may be given to wealth statistics, which are assumed to indicate incomes received by consumers. Wealth statistics, as a rule, have little significance in market analysis. In the first place there are no reliable wealth statistics and, in the second place, even if such statistics were available, they would give slight clue to the probable demand for any particular article. Wealth statistics are published, to be sure, by the United States Government, but they are rough approximations. Land values, always difficult of determination on a comprehensive scale, make up a considerable part of the total wealth estimate and numerous other items are included, the value of which cannot be determined with exactness. These figures, furthermore, represent chiefly the value of tangible property, which is reported as part of the wealth of the district where the property is located though it may be largely owned by stock-

holders or others who reside elsewhere and spend in other markets their income from the property.

Wealth statistics are commonly reduced to a per capita basis, but a per capita wealth figure is of little worth for any purpose, for it does not show the distribution of the wealth. It makes a vast difference to a manufacturer looking for prospective markets whether the wealth in any district is fairly evenly distributed among the consumers or concentrated largely in the hands of a few very rich persons; the quantity of any commodity purchased by an individual consumer seldom varies in direct proportion to his wealth or income. The man with an income of $50,000 does not buy fifty times as much food nor fifty times as many watches as the man with an income of $1,000.

Finally, even if the wealth figures were available in such form that they could be relied upon and the distribution of the wealth among the population ascertained, the figures would not accurately indicate market potentialities. Not only are wealth statistics inadequate indices of incomes, but different classes of people engaged in different occupations and living under different conditions do not expend their incomes in the same way even if those incomes are approximately equal.

Average wages are another set of statistics occasionally referred to as furnishing an index of potential demand. The United States Bureau of the Census publishes average wage statistics, and similar figures may be obtained from other sources. An average wage, however, for all the persons engaged in manufacturing in Massachusetts, for example, includes the wages of numerous highly skilled workmen and also the wages of unskilled men, women, and children. The average is not representative and does not indicate that Massachusetts is necessarily a poorer potential market for any manufacturer than some other States where the average wages may be higher.

Per capita consumption figures for large groups of commodities, such as clothing or foodstuffs, are finding their way into some advertising publications, as affording a guide to potential markets. The only per capita consumption figures which are worthy of consideration are those for such articles as coffee or sugar, where

fairly accurate records of importation and domestic production are maintained. The Census figures for the value of the product of the various manufacturing industries are too inaccurate, in the form in which they are presented, to be acceptable as a basis for estimates of per capita consumption, and there is too great uncertainty as to the amounts added to the manufacturers' selling prices in the course of the marketing processes to warrant placing any reliance upon estimates of total retail selling value or total amounts paid by consumers for these products. These per capita consumption figures, moreover, are gross figures including many grades and qualities, some of which are virtually non-competing. Such statistics are of little aid in making a careful market analysis.

Instead of attempting to use statistics for wealth, income, or per capita consumption, the first task in undertaking a statistical analysis of a market is properly to determine just what class or classes of consumers constitute the potential market and, if there are varying degrees of demand, what demand may be expected from each class. For this, personal investigation or inquiry may be necessary. The next step is to ascertain the number of consumers of each class in each sales district. From these two sets of statistics the total potential demand for each district under normal conditions can be estimated.

These figures for estimated potential demand, when compared with past sales records, show in which districts the best opportunities exist for sales development and serve as a basis for establishing quotas for salesmen. Ordinarily the comparison of sales records with estimated potential demand shows that the degree of saturation is not uniform in all markets. It is usually found upon investigation that a higher percentage of potential demand has been realized in some markets than in others, thus indicating the direction in which expansion may most readily take place. Due allowances for these differences in the degree of saturation must be made, of course, in setting up quotas by means of which salesmen are to be rated. A district in which only 25 per cent of the potential demand has been obtained offers a much easier field for selling than a district in which there is a high degree of saturation but, while he should show a greater per-

centage increase, the salesman in the former district cannot be expected to reach the mark of the salesman in the second district in a single season.

Another factor to which attention may be given in analyzing a market for some products is the percentage of distribution,—that is, the percentage of the total number of possible retail outlets in which the goods in question are sold. A manufacturer of a food product sold in retail grocery stores generally wishes to induce as large a number of grocers as possible in each district to carry his product. If 75 per cent of the retail grocery stores are selling the article, he considers that he has 75 per cent distribution, without reference, of course, to the relative volume of trade of the retailers.

In establishing sales quotas, allowances must be made not only for differences in degree of saturation and percentages of distribution but also for differences in general business conditions. From season to season general business conditions fluctuate in each district. A poor cotton crop may cut down the normal demand in the cotton states while a good grain crop in the same year may cause business to be exceptionally brisk in the wheat district. Hence the statistical indices of business conditions in each district must be taken into account in comparing salesmen's records with established quotas.

Sales Reports and Records

Market analyses are valuable not only for indicating districts which are underdeveloped as markets but, as has been indicated, they are especially useful in furnishing standards for rating salesmen. Yet whether or not an analysis of the market is made, salesmen's reports and salesmen's records are essential to proper sales management and the summaries of departmental sales and of total sales provide the general management with vital information.

From the individual reports sent in daily or at frequent intervals, statistical records are made out in order that total sales, departmental sales, and the sales of individual salesmen may be compared with previous records and with established standards.

The exact form of the sales record varies according to the requirements of each individual business and the greater the number of lines of merchandise carried the more detail is needed in the sales record. A hardware wholesaler, for example, will wish to have the sales records of his salesmen classified into at least half a dozen groups of articles in order that he may determine whether or not each salesman is developing properly the sales of the lines yielding the greatest profit. A hardware salesman whose sales of nails are increasing and whose sales of cutlery are falling off is not a promising employee. Likewise the wholesale grocer who finds that one of his salesmen is good at selling sugar but poor at selling other lines has discovered a weak spot in his salesforce.

In trades where the salesmen call upon the same customers at repeated intervals, as for example in the wholesale businesses, customers' records are usually found to be valuable. The most common form of customers' records is a set of cards, one card for each customer, on which are recorded the orders received from each customer. Although the same information can ordinarily be obtained from the ledgers, the separate card record is needed by the sales manager. By examining these cards the sales manager is able to ascertain which customers, if any, are buying less than formerly and which customers have ceased to buy at all. It frequently happens that customers cut down their purchases because of dissatisfaction or friction which can easily be remedied once it is known but which may never be detected without customers' records. It is fully as important to keep old customers as it is to secure new customers. Several examples of the utilization of sales and customers' records are given in the sections which follow.

Advertising Statistics

The subject of statistics used in the advertising department as guides for the selection of mediums and for checking up results is covered in the following sections and it is not necessary to add anything to what is stated there.

Statistics Used in Retail Stores

The statistical records which are kept in retail stores are analogous to those kept in other mercantile establishments, but the form and the amount of detail vary greatly according to the size of the store and the nature of the business. In retail businesses, as in all other lines of business, the cost of keeping the statistical records has to be weighed against the advantages to be gained therefrom; a small store cannot afford to use as elaborate a system as a large store. A department store, for example, can keep daily records of its sales by departments and by salespersons, detailed wage statistics, complete delivery records, purchase and stock records, and an elaborate budget system. In a small grocery store, on the other hand, some of these records must be dispensed with.[1] Even in the smallest retail store, however, there are some records which are essential — a record of the sales of each salesperson and either a stock or a purchase record. If the salesforce expense is to be kept at a minimum, the work of each salesperson should be watched continually by means of accurate sales records.

In retail stores generally, one of the most serious causes of loss is a slow stock-turn, owing to over-buying or to poor buying, and either a stock record or a purchase record is needed by every retailer. In a retail shoe store it is ordinarily possible to keep a record of sales and stock in detail, since the number of lines carried in a single store is not great.[2] In a retail grocery store or in a retail hardware store, on the other hand, there are hundreds of different articles and brands which are sold in small quantities; in such stores a continuous stock record can seldom be kept without excessive expense. For stores of this latter class some sort of

[1] In general, it may be said that in retail stores customers' records are kept only for advertising or mail order purposes, not as statistical records. Individual customers are too numerous, their individual purchases too small, and the independence of their demand too great, to make it worth while to keep any customers' records, aside from those in the ledgers, in the ordinary retail store.

[2] A complete system of stock records for retail shoe stores is explained in Bulletin No. 7 of the Harvard Bureau of Business Research, *Harvard System of Stock-keeping for Shoe Retailers.*

purchase record seems to offer the best means of checking up the rapidity with which the various articles move. If a card record is kept for each brand of merchandise and each purchase order is properly recorded, the retailer can easily determine which brands are the "slow movers" and what changes in his buying policy are necessary in order to increase his stock-turn.

Many mercantile businesses, both wholesale and retail, and many manufacturers are constantly troubled with the return of goods from customers to whom they have been sold. Nice questions of business policy are involved in handling this problem of returns, but whatever policy is pursued it is important to have a statistical record of "returns." Frequently "returns" are entered upon the sales records of salesmen and upon customers' records, in order to provide information to aid in placing the responsibility and thus in determining the policy of the management.

I. Considerations of the Market[1]

By A. W. Shaw

The business man must first realize the intricacy of the problems he has to solve. He must analyze his market. Enough has been said to indicate the complexity of the market problem. The business man faces a body of possible purchasers, widely distributed geographically, and showing wide extremes of purchasing power and felt needs. The effective demand of the individual consumer depends not alone upon his purchasing power but also upon his needs, conscious or latent, resulting from his education, character, habits, and economic and social environment. The market, therefore, splits up into economic and social strata, as well as into geographic sections.

The producer cannot disregard the geographic distribution of the consuming public. He may be able to sell profitably by salesmen where the population is dense, while such method of sale would be unprofitable in a region where there is a sparse population. If he bases a judgment upon the average cost of selling by

[1] A. W. Shaw, *Some Problems of Market Distribution*, pp. 100–117. Reprinted by permission of Harvard University Press.

salesmen for the whole market, he may easily go wrong, since the average might show that the use of such an agency was on the whole profitable, although in some sections entering into the calculations the use of salesmen was actually unprofitable. Again, it might be economical for the distributor to establish his own branch stores in the denser urban centers, while in the sparsely populated regions he could most profitably distribute his product through the regular channels.

If, then, a sound system of distribution is to be established, the business man must realize that each distinct geographic section is a separate problem. The whole market breaks up into differing regions.

Equally important is a realization of what may be termed the market contour. The market, for the purposes of the distributor, is not a level plain. It is composed of differing economic and social strata. Seldom does the ordinary business man appreciate the market contour in reference to his product. Yet obviously the success of the producers of trade-marked hats depends upon a realization of this element of market contour. The distributor of a staple hat at $3.00 appeals to different economic and social strata, faces different considerations, and finds different selling methods necessary, as compared with distributors selling a $5.00 trade-marked hat, or those distributors selling $4.00 or $6.00 trade-marked hats. Differences in economic and social strata to be reached are as important as differences in geographic location and density, if a sound system of distribution is to be worked out.

Take the distributor who seeks to map out a selling campaign for a Catholic publication. It is essential that he take into account not merely the geographic distribution of the Catholic population in the United States, the regions where it is relatively dense, and the regions where it constitutes a small element in the population, but also he must take into account the distribution of that population through the economic strata of society. A method of distribution successful in New Orleans, where the Catholic population is dense and spread through all economic strata of society, might well fail if applied in Maine, where the

Catholic population is relatively sparse and found mostly in the lower economic strata.

A careful analysis of his market, then, by areas and by strata, is the first task of the modern distributor.

Choice of Agencies in Distribution

Nor does the merchant-producer ordinarily realize how intricate is his problem as to the agency or combination of agencies that will be most efficient in reaching his market. As has been suggested above, the business man often adopts one method and becomes an advocate of it, disregarding entirely other methods. While the method adopted may be more efficient than any other *single* method, it is apparent that a method which is relatively efficient in reaching one area may be inferior to another method in reaching another area. And so a system of distribution which has proved very effective in reaching one economic stratum may be relatively inefficient when employed to reach a different economic stratum in society.

The problem, then, of working out the most effective combination of agencies is a most complicated one. Each distinct area and economic stratum must be treated as a separate problem, and, moreover, the economic generalizations embodied in the law of diminishing returns must be taken into account in choosing that combination of selling agencies which will give, in the aggregate, the most efficient organization of the market.

Thus the distributor may find as he extends his operations in his immediate territory, geographically, that his selling cost steadily decreases, but that when he further extends his market the selling cost increases. He may find that in more distant areas selling by salesmen ceases to be profitable, and there he will perhaps establish a more economical system of selling by a combination of salesmen and circular letters. That is, he may reduce the number of visits by salesmen by one-half, and supplement their efforts by a series of circular letters or more personal correspondence. In even more distant areas, it may be necessary to eliminate the salesmen entirely and to sell only by direct advertising.

Perhaps enough has been said above, in analyzing the functions of the middleman and the extent to which the rise of functional middlemen has made alternative agencies of distribution possible, to free us from the necessity of here pointing out at length how complicated is the problem presented when the business man balances distribution through middlemen against direct selling through salesmen and advertising.

Attention must be called, however, to considerations that enter when one compares the use of salesmen with the use of different forms of advertising. The business man will often judge between different selling agencies solely upon the basis of the direct return over a short period. In discussing advertising we spoke of three classes of demand aroused by selling effort: (1) expressed conscious demand, (2) unexpressed conscious demand, and (3) subconscious demand. The direct and immediate return from selling efforts depends solely on expressed conscious demand. But the business man must take into account the unexpressed conscious demand and the subconscious demand. Suppose a smoking tobacco is advertised. A man notices the advertisement, reads it, and decides that at some future time he will try it, and perhaps months later does so. This is not reflected in the direct immediate returns, yet clearly it is a result to be taken into account. Or suppose a man merely notices the advertisement. At a later date when purchasing tobacco, he is shown the advertised brand with other brands. The advertised brand being vaguely familiar to him from the advertisement, he purchases it in preference to the others. Here, too, the aroused demand would be of a degree not reflected in direct immediate returns, yet of value to the distributor.

It is obvious, then, that if one were balancing the advantages of selling through salesmen against selling through advertising in whole or in part, he should consider not only the expressed conscious demand reflected in the direct immediate returns but also the lesser degrees of demand which, while not immediately effective, tend to render subsequent selling easier.

Thus a salesman might make fifty calls at an expense of $100, and ten sales might result from his efforts. Or for the same $100,

5000 pieces of direct advertising might be mailed, resulting perhaps in only eight sales. Or, perhaps, if the same $100 were used for the insertion of a page advertisement in 100,000 of the circulation of a standard magazine, only six sales would result. Now it is apparent that judging by the direct results, the salesman is the most efficient agency of distribution, the direct advertising next, and the magazine advertising least efficient. But the distributor must bear in mind that there are grades of demand which do not become effective immediately, and must take into account that while the salesman made ten sales he had only forty opportunities to create these lesser grades of demand, while the direct advertising gave 4,992 opportunities for the creation of demand falling short of expression, and the magazine advertising, perhaps, 49,994 such opportunities, assuming for our present purpose that the advertisement was seen in one-half the copies by one person. This is not an improbable supposition as each copy of a magazine is usually read by several persons.

A sound selling policy, then, must be built up on a careful analysis of the market by areas and strata, and upon a detailed study of the proper agency or combination of agencies to reach each area and stratum, taking into account always the economic generalizations expressed in the law of diminishing returns. It must also take into account not only the direct results obtained from the use of one or the other agency over a short period, but also the less measurable results represented by the unexpressed conscious demand and subconscious demand, which go to aid future selling campaigns.

All this tends rather to give a general sense of direction than to serve as a practical and tangible method of handling a specific problem of distribution. A clear grasp of the problem through a careful analysis is the first step in solving difficulties. To suggest any cure-all or even any panacea for the existing maladjustments in distribution, even were it possible, is not the purpose of this paper. The very complications revealed by analysis indicate the inadequacy of any single remedy. But it is possible to face the problem of remedy as well as of diagnosis in a scientific spirit, — to introduce what may be termed the "laboratory method."

Laboratory Study of Distribution

The crux of the distribution problem is the proper exercise of the selling function. The business man must convey to possible purchasers through one agency or another such ideas about the product as will create a maximum demand for it. This is the fundamental aim, whatever the agency employed. Hence this is the point where a scientific study of distribution must first be applied. How is the business man to determine what ideas are to be conveyed to the possible purchaser and what form of expression is best adapted to such conveyance?

Here, as elsewhere in distribution, the ordinary business man is today working by rule of thumb. He *guesses* at the suitable ideas and forms of expression, and gambles on his guess. On the basis of his *a priori* selection of ideas fitted to build up a demand for his product and of a form of expression suited to convey the ideas effectively, he invests tens even hundreds of thousands of dollars in a selling campaign.

The more able business men, to be sure, seek to determine those facts about their goods that will attract the attention of the possible purchaser and awaken in him the desired reaction, that is, a desire for the article. They study in a general way the points of superiority in quality and service possessed by their products as compared with other goods of like kind.

They also seek guides as to the form in which the ideas should be conveyed, in the general principles of style, all based on the fundamental notion of conserving the prospective purchaser's mental energy by cutting down the friction of communication. They know, for instance, that they should use short familiar words expressing their exact shade of meaning; that they should give preference to figurative language; that they should suggest a concrete image only after the materials of which it is to be made are conveyed; that they should avoid abstractions and generalizations where possible; that when they are suggesting the reaction desired their language should become quick, sharp, and compelling.

These things the more efficient business men know and apply. But all this is *a priori*. The need is for a method of practical test

that will enable us to try out selling ideas and forms of expression, under laboratory conditions, as it were, before the investment of thousands and hundreds of thousands of dollars is staked on the success of the selling campaign.

Mention has been made of the annual expenditure of not less than a billion dollars in advertising. Unquestionably an extremely large percentage of this is wasted. This means not merely individual loss, but social loss. It is a diversion of capital and productive energy into unprofitable channels.

The causes of this waste are numerous. The commodity in question may be one not possessing those elements of quality and service which constitute the basis for a demand on the part of the consuming public. If the goods advertised are not adapted to satisfy a need, conscious or subconscious, of consumers, the advertising cannot be effective. Attempting to sell a thing that nobody needs is wasted effort.

Again, the medium used for the communication of the ideas about the goods may not be one that reaches the particular economic or social stratum in which possible purchasers of the commodity lie. Hence the ideas fail to create a demand because they do not reach those in whom a latent need for the commodity exists.

Another important cause of advertising waste lies in the failure to take advantage of aroused demand. The distributor often fails to give proper attention to the matter of the physical supply of his product. There results a considerable leakage in demand from the inability of persons in whom a demand has been created to obtain the goods at the time when desired.

But the great cause of waste is probably the fact that the ideas about the goods, or the form in which those ideas are conveyed to possible purchasers, prove ill-adapted to secure the desired reaction, and thus to create in the consumer an effective demand.

If we can apply to this pressing problem of advertising waste methods of study which have proven efficient in other fields, the gain is clear. The engineer does not choose material for a bridge by building a bridge of the material and waiting to see whether

it stands. He first tests the material in the laboratory. That is what the business man must do.

The statistician turns in his problems to the law of averages. He is familiar with what are termed mass phenomena. He knows that he can learn something of the average height of a body of people by studying the heights in a group of a few thousands of people drawn at random from the larger body. Provided that the smaller group is so selected as to insure that it is typical of the larger body, and provided the group is large enough to render the law of averages applicable, the statistician knows when he has determined the average height of the smaller group that it will roughly coincide with the average height of the larger group.

This method of study can be applied by the business man in testing the ideas and forms of expression to be used in a selling campaign. In direct advertising, the mailing of selling letters, circulars or catalogues to prospective purchasers to draw from them an order for goods as an evidence of awakened demand, you have a stimulus and response adapted to direct statistical measurement. The number of responses per thousand communications can be determined. Here is the agency that the business man can employ in testing, under what are equivalent to laboratory conditions, the ideas and forms of expression that seem to him best adapted to awaken a demand for his product.

Suppose the manufacturer of a food product is planning a campaign to reach, not the consumer, but the grocers of the country. Now the whole body of dealers, large and small, handling groceries numbers something like 250,000. Let the distributor, after working out a set of ideas and forms of expression which seem to him likely to be effective in arousing the desired demand, test this material by mailing it to say 1,000 grocers. The group selected must be large enough to give typical results and it must be so selected as to be representative in character of the whole body of grocers.

Granting these elements, the distributor can determine the number of responses from the 1,000 grocers to whom the communication was sent, and can estimate from that result the average response per thousand of communications that would have

been obtained if the same ideas in the same form of expression had been conveyed to the whole body of 250,000 dealers in groceries in the country. He can then test by means of direct mailing to another group of 1,000, a varying set of ideas or varying form of expression. And so on with other modifications of the selling

TABLE I. BANKERS' TESTS

Minimum Standard = 20 per M.

Material mailed[1]	Tests				Mailings			
	Date	No. of pieces mailed	Total orders received	No. per M.	Date	No. of pieces mailed	Total orders received	No. per M.
	1909				1909			
A^1	3/30	500	3	6				
A^2	3/30	500	5	10				
B^1	8/13	500	6	12				
B^2	9/13	500	3	6				
C^1	9/15	500	4	8				
C^2	9/15	500	3	6				
D^1	9/15	453	6	25	9/27	19,934	360	18
D^2	9/15	500	18					
E	9/16	500	7	14				
F^1	9/21	500	24	36	11/23	16,511	589	35
F^2	9/21	500	12					
G	10/18	1,000	30	30	11/28	21,790	643	29.5
					1910			
H	11/16	500	11	22	1/24	6,554	165	24
					1/24	16,039	390	
	1910							
I	4/11	500	12	24	5/5	6,810	145	25
	4/11	500	12		5/4	12,154	336	

[1] Where the same letter appears with different exponents under "material mailed" it indicates that on the test mailing results were kept separately for the same material mailed to two small groups.

material. Thus it will be possible to determine what ideas, in what arrangement and in what form of expression, are most effective to arouse the desired demand.

That the plan suggested is practical is indicated by the results of such an intensive study presented in Table I. Here are shown the results of " tests " and the results of complete mailings. The tests here covered only one stratum of society, a mailing list of

bankers being used. The purpose of the selling material mailed was to obtain orders for certain publications. Various forms of "copy" were tested by mailing, usually to 500 names on the list. Where the return on any test exceeded the minimum standard of twenty orders per thousand communications the material was mailed to the complete list. In only one case did the complete mailing fail to show an average return per thousand communications substantially the same as that derived from the test mailing. In the case of Test D^1, mailed September 15, 1909, the return is clearly out of proportion to the results from the mailing. The same material mailed on the same date, however (Test D^2), gives for a similar small group a return much closer to the results obtained from the final mailing. When a minimum standard as low as twenty is used, and the test group numbers only 500, there is danger that the average will be disturbed as by one individual sending in several orders. The larger the test group the more exact an index will it give as to the results which will be obtained from a complete mailing.

This method of studying ideas and forms of expression in direct advertising would be important, even though its usefulness did not extend beyond direct advertising. It would permit one to guide a widely extended direct advertising campaign by an investigation relatively inexpensive.

But the importance of the method described does not end with direct advertising. Remember that the root idea is the same, whatever the agency for selling employed. Selling is accomplished by communicating to the possible purchaser ideas about the goods calculated to stimulate in him a desire for the goods. These ideas may be communicated through middlemen, salesmen, general advertising or direct advertising. Since the ideas are the same, whatever the agency for communication, the business man can determine in his direct selling laboratory what ideas and in what combination are the most effective selling material. He can then carry over into his selling by other agencies the knowledge there obtained.

Suppose an extensive campaign through periodicals is under consideration. The distributor contemplates spending perhaps

hundreds of thousands of dollars upon advertising in certain periodicals. What can the "distribution laboratory" do to determine the ideas to be conveyed and the forms of expression to be used to create the desired demand? Now the circulation of a periodical to be used may run into the hundreds of thousands or even into the millions. The business man wishes to test the response that will result from the communication to this enormous body of subscribers of certain ideas expressed in certain forms. Not only can he work out the most effective ideas, the most effective arrangement, and the most effective form of expression through the agency of direct mailing, but he can even test the final "copy" itself, just as it will appear in the periodical, by mailing it directly to relatively small groups.

Moreover, he can test the response to it found in differing strata of society. Ideas adapted to build up a demand for a commodity in one economic or social stratum may prove ineffective when dealing with another. The importance of this method lies in the fact that most periodicals circulate within certain fairly well-defined economic and social strata. The ideas and forms of expression that are most effective in one periodical hence may be relatively ineffective if used in another that reaches a different stratum.

Equally important is the application of the suggested method of study to selling through salesmen. The more progressive business men today train the salesmen in a certain basic "selling talk." That is, certain ideas, arranged in a certain order and expressed in certain forms, are impressed upon them as likely to build up a demand for the article on the part of possible purchasers. The basic "selling talk" is not, of course, repeated parrotlike by the salesman, but it does serve as a foundation for his talks to possible buyers.

Here again the laboratory idea can be applied. The whole structure of the selling talk can be built up on the ideas, order of arrangement, and forms of expression established as the most efficient in creating demand through the medium of direct advertising. One need but appreciate the fundamental identity of the selling function, through whatever agency exercised, to

realize that the results obtained in experiments in direct advertising can be carried over to selling by salesmen.

Note, too, that the general principles, upon which the "testing" method depends, apply when we seek to study the possibilities of the whole market by the intensive cultivation of one section of it. A localized selling campaign, narrow in extent, will give relatively exact data from which the possibilities of a nation-wide campaign of like character may be judged. Obviously, if our law of averages holds good, we may carry over the results obtained in one section to other sections, and hence at small cost guide a widespread campaign.

The exact data that can be obtained through such "testing" methods permit a more scientific consideration of the decreasing returns obtained if one agency is used beyond a certain point. Hence a better combination of agencies is possible, with a view to the greatest aggregate efficiency.

II. Why and How a Manufacturer Should Make Trade Investigations[1]

By C. C. Parlin

One of the amazing things in industry is the fact that vast sums of money are being risked in enterprises undertaken upon guesswork. While some manufacturing enterprises have been started only after a careful study of conditions, others have been instituted after a few inquiries and upon a decision to take the chance.

Much of this attitude is a legacy of the past when conditions were essentially different from today. In the earlier period of our manufacture the markets were clamoring for goods. The manufacturer had but two problems: first, to make the goods, and second, to get them within reach of the consumers.

Today the supply in most lines has caught up with the demand and a third very important function devolves upon the manufacturer; namely, to develop his markets. This function involves first of all a thorough knowledge of his existing markets and of all

[1] *Printers' Ink*, October 22, 1914, pp. 3–12, 74–80. Reprinted by permission of *Printers' Ink*. Several charts have been omitted.

those influences which are operating to affect them. It seemed natural enough in the earlier stages of industrial development for the manufacturer to confine his attention to the making of goods and to entrust to an outside sales organization the second function of getting the goods to the consumer. It is still advantageous in many lines for the manufacturer to reach the retailer through jobbing connections, but no manufacturer, however efficient and honorable the middlemen handling his product are, can afford to be without first-hand knowledge of his markets. Every manufacturer should know where his goods are sold, who buys them and why they are bought, what type of men are selling his goods to consumers, what influences are affecting them, what their sales methods and sales costs are, to what extent they are real factors in making sales and to what extent they are only order-takers.

Every manufacturer should know whether he has a uniform distribution or whether there are certain sections and communities within sections where sales are subnormal; many manufacturers reaching the retail trade through middlemen seem to have very little of this information. Those who sell through a sales organization sometimes do not know what jobbers buy their goods or what the geographical distribution of their goods is. Those selling to jobbers have some knowledge of the geographical distribution of the goods, but often have little information as to what proportion of their goods goes to cities and what to rural trade. They know little in regard to the retailer and his problems. They do not know what consumers buy goods or what influences affect the consumers' choice. In general, these manufacturers know only what the jobbers tell them; and why should the jobbers tell them much?

Manufacturers who sell part or all of their goods direct have more information, but this often reflects merely the salesman's viewpoint and does not portray the entire field.

Besides a thorough knowledge of existing sales conditions the manufacturer should study potential markets, and how they can be developed, what the influences of new sales methods are and what influence new methods of exploitation would have on the

industry, what new uses can be found for the product, what detrimental influences are at work and how they can be checked or removed, how retailers can be best persuaded to give efficient coöperation and how consumers can be most effectively reached.

To say that knowledge is power is trite but it is true. Knowledge is the foundation of modern merchandising, and as competition grows more intense, it becomes more apparent that the manufacturer must know in order to succeed.

But a manufacturer says, "Why have a research department? I have thirty salesmen. If I want to know anything I ask them."

To this query there are two obvious answers: First, because these men are salesmen. They are honest and efficient, but they have a salesman's viewpoint and a salesman's prejudices. Their opinion is of great value, but by the very fact of their specialization in salesmanship they are handicapped in getting an impartial view of the situation. They see a part of the truth too clearly to get a fair vision of the whole truth. Second, because the function of a research department is not only to answer questions but to discover influences that are escaping the attention of the manufacturer and his sales organization. It is only natural that any organization which specializes on a certain phase of an industry should in the gaining of intensive knowledge of that phase lose something of the perspective of the whole. A research department is therefore needed to supplement and broaden this specialized knowledge with pertinent information from allied fields.

As competition in business has grown more acute, there has been a greater necessity that every factor should be understood and every danger guarded against in order that success may be attained. Hence, there is an increasing necessity for research departments in business enterprises.

The manufacturer gets an intensive knowledge of those phases of his business with which he comes in daily contact. But frequently there exist other phases with which he has little contact. He therefore has little knowledge of their importance. From the very fact that a manufacturer gives intense attention to certain phases of his industry, these phases tend to assume undue importance in his mind and it is difficult for him to obtain a well-

balanced view of the field unless his own experience is supplemented by research into those portions of the work which are least understood.

For example, the manufacturer who sells exclusively through jobbers has little opportunity to judge of his possibilities through direct sales. The manufacturer who uses no national publicity usually fails to see the possible development of his business through national advertising. A manufacturer, particularly one who sells through indirect channels, often has little knowledge of the distribution of his product — who buys the goods, why certain lines are selected and others rejected. On the other hand a manufacturer who does have considerable knowledge about the distribution and sale of his own lines may not be conscious of some general influence operating in the retail and jobbing field which may greatly affect his selling problems. Hence as a result of research work manufacturers have usually obtained suggestions of value and sometimes have been led to change entirely their selling systems.

A certain manufacturer in the Central West was interested primarily in breaking into the New York markets; research showed him that totally neglected at his own door there lay a larger market easier to get and likely to prove more profitable than the coveted New York market; research showed another manufacturer that his distribution was far from uniform, another that he was restricting his line to jobbers when the possible sale for his goods was almost confined to those stores which aimed to buy direct, another who sold only direct that a major portion of the opportunities in his field could be best reached through jobbing channels.

Granting the value of research work, the chief problem is, How may it be conducted to produce results commensurate with the expenditure?

In commercial research work as in most other lines of intellectual endeavor, the man is more important than the method. Essentially, the thing to do is to get a competent man and give him much latitude both in method and in subject matter; for the problems in each industry are so individual and so complex

that no satisfactory formula for procedure can be laid down, and much must be left to the initiative of the man conducting the work.

At first sight, it might appear that the problem of a research department is to answer inquiries, and a man taking charge of the work is likely to ask, " Exactly what problems am I expected to solve ? " The answering of inquiries is valuable and may be well worth what it costs, but a research department, in order to attain its greatest usefulness, must go considerably beyond the answering of questions and perform the higher function of formulating questions which ought to be asked.

It might appear that the company would be in a position to state exactly what information would be of value, but after asking many manufacturers what problems they desired to have studied, I am satisfied that one of the greatest services of a research department is to ask new questions. When a manufacturer has formulated in his mind a question for which he seeks an answer, all his experience, reading and thinking are brought to bear upon its solution, and while a research department can accumulate data that will help him in reaching a conclusion upon that point, it can perform a more valuable service if it can discover tendencies of which the manufacturer is not conscious and ask him questions which will lead to new lines of thought.

Research work should not only be dominated by honesty of purpose, but it should be conducted from the student standpoint of truth for truth's sake. Lines of inquiry that appear likely to prove of practical value should, of course, be pursued. But that which appears academic should not be neglected, for it frequently happens that what appears to be academic turns out to be highly practical, while something which appears likely to be practical often turns out to have little value.

It is probably advantageous for a research worker to approach his problem without special knowledge of the particular industry to be studied. A man who has had several years of experience in any given industry has formed such definite opinions of that industry that he cannot easily formulate well-balanced judgments on its problems. The research worker's function, in some respects,

is like that of the juryman, for whom one of the requirements is that he know nothing about the case.

The methods to be applied to commercial research are analogous to those used in science; namely, the gathering of a mass of facts and then, with an abundance of data before one, proceeding cautiously from the particular to the general.

Some of the broader aspects which should be borne in mind in formulating conclusions may be suggested here.

First, tendency toward concentration. It is of vital importance to a manufacturer to know whether the industry in which he is operating is tending toward concentration, and if so, to what extent that concentration is likely to be carried.

In general, industries may be divided into two classes: those making utilities and those making style goods. Utilities comprise those articles which are bought by the consumer solely on the basis of quality or efficiency for the price and without thought of their pleasing his taste or fancy: e. g., agricultural implements are utilities. They are judged solely on the basis of performance in proportion to price. What mechanical principle is employed and whether the lines of the machine are pleasing to the eye make little difference if efficiency be there.

Style lines are those in which the consumer's preference is determined by qualities other than utility — all those lines which appeal to individual tastes and fancies. In general they are the lines that involve the element of adornment and display, such as clothing of all kinds, jewelry, dress accessories, household furnishings and decoration.

Many lines are at the same time utilities and style goods. For example, clothing and furniture in certain grades are bought primarily for serviceable qualities, but in other grades must meet the most exacting requirements of style. In automobiles, the truck is a utility; i. e., is judged on its ability to produce wealth. The pleasure car, on the contrary, is both a utility and a style carriage. In addition to meeting the demand for mechanical efficiency it must meet the style demand of the moment; and these style demands affect not merely body lines, location of doors, and other appearance features, but also cover equipment

and choice of mechanical principles. If, for example, a purchaser in choosing between a " six " and a " four " is swayed by motives other than those of efficiency and price, if he buys the one or the other to have the same kind of motor as his friends, or makes his choice because the one or the other simply pleases him the best regardless of purely economic reasons, the sale is made according to the laws of style goods rather than of utilities.

It is important for a manufacturer whose line falls somewhere in this vast intermediate field to determine to what extent style influences are controlling the industry, for the manufacturing and sales tendencies in style lines are fundamentally different from those in utilities.

In utility lines, theoretically, a single concern, if it excelled, would secure an entire monopoly; for if a manufacturer so perfected his manufacturing process that he was universally acknowledged to have the most efficient article at the price, theoretically everyone would buy his product. Practically, if one manufacturer can attain a very high degree of efficiency in manufacture, another can develop near enough to his standard to be a competitor; and practically, there is a value in a name, and there is a difference in public opinion. Hence it seldom happens that in any line where there is no protection by control of raw material or patents, anyone does attain an absolute monopoly. However, in these lines there tends to be concentration down to a very small number of manufacturers, unless freight conditions affecting raw materials or finished product necessitate a sectional distribution of plants.

In the manufacture of utilities, as concentration progresses, it becomes increasingly difficult for a new firm to gain a foothold; for ordinarily the new manufacturer has to pass through an unprofitable period before he attains efficiency enough in manufacture to hold his own in competition with monopoly. In these lines where the economic tendency is toward concentration, there is no place for the small manufacturer unless he can adapt his product to meet some peculiar local need, and no place at all for the middle-sized producer. The manufacturer is likely to face the alternative of growing great or being crowded to the wall.

In style lines, on the other hand, people buy not only quality and efficiency but also an intangible something which by its display represents the owner's individuality. Since there are many types of individualities there must be a considerable number of manufacturers to supply the individual wishes. In the manufacture of a style line, whenever a manufacturer gets a majority of the market a style reaction sets in against him. Thus it comes about that no one can gain and permanently hold any large per cent of the total market. Hence there are bound to be a considerable number of producers, and their relative rank is likely to vary from season to season as a fickle public smiles first on one, then on another. In these lines the opportunity for the small and medium-sized manufacturer continues; for in style lines there are always people who desire something unique and thus furnish a chance for the specialty manufacturer with a distinctive product to maintain his existence without growing great. For the same reason there is always an opportunity in the manufacture of style lines for a new concern to gain a foothold if it can make a successful appeal to the human desire for display.

Obviously, then, one of the most important things to be determined in any business is the extent to which style influences control the industry and the extent to which the tendency to concentration is likely to proceed. Upon an understanding of these problems and upon the direction of the company's activities in harmony with the tendency of the industry may depend the very existence of the firm.

Second, convenience goods or shopping lines. If the manufacturer produces an article sold to the consumer, it is important to know to what extent it is bought by men and to what extent bought by women, for men and women purchase through different motives.

A man ordinarily buys either at (1) the most convenient place, (2) by impulse, (3) in an accustomed place, or (4) by brand. He does not compare values and there is little tendency for his trade to be concentrated in shopping centers or in large stores. In general, men's trade is held back in the suburban places and remains scattered in a multitude of small establishments.

Women's trade, on the contrary, is of two distinct kinds: (1) convenience goods and (2) shopping lines.

Convenience goods comprise notions, cheap cottons, and, in general, the lower end of women's purchases.

Shopping lines, in general, comprise the upper end of women's purchases, such as cloaks and suits, draperies, carpets, millinery. In the purchase of convenience goods the woman ordinarily buys on the same motives as the man: that is, at the most convenient place, or on impulse, or sends the children to an accustomed store, or orders by brand. These lines, like the men's, find their sale in a multitude of suburban shops or crossroad stores and the manufacturer who would sell these lines must have the assistance of the jobber.

In the purchase of shopping lines, on the other hand, the woman does definitely want to compare values (apparently in three stores) and the department store, which is organized to furnish facilities for women's shopping, tends to get the great bulk of this trade. Hence the trade in shopping lines is sharply concentrated in a comparatively small number of shopping centers and in a few stores within those centers.

It is of prime importance to a manufacturer to determine in which classification his goods fall and to what extent either shopping or convenience buying is the prevailing motive. Upon this depends his method of sale. If he has a men's line or a convenience line, his distribution is widely scattered and the multitude of small merchants handling his wares prefer to buy of the jobber. Such a manufacturer therefore should not push his direct sales methods farther than is consistent with a jobbing policy. In some lines he will find it advantageous to supplement his jobber program by selling direct to those large stores to which he may sell without jeopardizing his jobber connections. If, on the contrary, he has a shopping line of any considerable volume, the direct sales method will be found best adapted to his needs; for the sale opportunities are confined to large stores, and, in general, large merchants prefer to buy direct. A clear understanding of such conditions is often necessary to determine the foundation principles of a selling system.

Third, scope of the market.

Such a retail investigation will need to be geographically extensive because the various sections of the country differ materially in buying power and in their attitudes toward various types of merchandising. Within each section considerable variation will be found in cities of different size and in cities that represent different types. For example, a residential city will ordinarily have more per capita buying power than an industrial city. A city with a large German population is likely to have a conservative per capita expenditure in department-store lines. A capital city tends to be subnormal in concentrated trade. A city in which wealth is concentrated in a few hands may show low per capita expenditures, while a city with wealth widely distributed will be found to be above the average. In general, retail and jobbing figures are merely the measure of human wants and economic possibilities, and when once the fundamental principles have been ascertained and the extent to which sectional, racial, industrial and climatic conditions modify these fundamental tendencies is understood, one may estimate with a fair degree of accuracy the probable market for a given section.

In estimating markets it should always be borne in mind that the potential market may be very different from the existing market. An industry which does not employ advertising may seem to have a small market, while if consumers were better informed the market might be much enlarged. Or an industry which sells direct when it should use jobbers, or *vice versa*, may fall materially short of satisfying its potential market. Hence, the potential market, though less tangible and therefore more difficult of study, offers the more important field for research work.

Fourth, seasonal sales.

The manufacturer usually is conscious of the extent to which his sales are affected by seasons, but the graphing of the seasonal curves often proves interesting and of value in planning sales efforts. For example, a graph of the automobile production and sales indicates two very unequal sales seasons; a major one in the spring and a minor one in the fall, with a style clean-up in mid-

summer and a stock clean-up in the late fall. A graph of the department-store sales indicates two nearly equal sales seasons, the graph tending to be symmetrical except for the influence of the holiday trade.

Fifth, fundamental tendencies in the trade.

The scope of a commercial-research department is to ascertain that which is fundamental rather than to give attention to the ephemeral.

In many industries it is necessary to forecast changes in fashion, and the value of this work is by no means minimized, but such work is so distinct from that of a commercial-research department that it belongs to a distinct department.

III. Finding the Facts that Count[1]

By J. G. Fredericks and F. M. Feiker

From a sixth-floor window a young advertising man looked out across the steam puffs and long roof lines of a four-hundred-acre plant. He was trying to match up the theories his chief was setting forth with the visible power spread out before him. The latter had just told him that the works would keep on running even though all advertising stopped.

" Momentum," the older man explained comfortably, " carries a big business through dull seasons. Our prestige, the fact that we have the largest organization, the biggest factory and the longest line, makes this business go — and grow."

The advertising man doubted. It did not seem logical that sales in the long run could be built on a passive, neutral basis. Experience urged that any business-getting plan or program should be grounded on facts and a knowledge of conditions as specific and certain as that obtaining in the research laboratory he could see down the factory street.

" Our sales have always fallen to thirty per cent of normal, during July and August," the manager of another business — this one a large, midwestern retail store — assured his new merchandise man when the latter took alarm at a sudden slump

[1] *System*, August, 1912, pp. 115–124. Reprinted by permission of *System*.

in receipts. "Our trade goes off to the country, and we simply have to accept the inevitable. The dull season means that we have to exert tremendous pressure during the fall, winter and spring to recoup the losses. But we've never failed to restore the average yet."

Was the factory executive right? Was the head of the department store sure of his ground? Are momentum and prestige, trade standards and customs, dull season and vagrant populations to be accepted as inevitable and unchangeable factors in distribution and merchandising? Are hostile conditions or circumstances felt rather than known certainly, to be allowed to limit production programs and marketing plans? Or are these oppressive conditions to be examined, dissected, remedied — and, perhaps, utilized?

Constructive business answers, no. That young advertising man, going back to his old place the other day, found a new chief busy with charts, diagrams and plans. He found him checking returns in different territories against quotas fixed by scientific study and investigation. He saw page after page of detail figures showing how much each district ought to yield and how much it actually had produced. He found the manager digging out the reasons why returns had not come up to expectations.

Business after business is probing into its own past searching for the solid basis of fact upon which to base future growth. New policies are forming. The progressive grocer no longer guesses which goods make his profits for him. He gets figures and knows. The advertising manufacturer or wholesaler no longer contracts for white space to be filled with mere publicity announcements. The retail merchant with the new point of view doesn't take the falling off in his summer trade for granted; he analyzes, gets at the facts, lays plans to counteract his decrease in volume.

When a new manager took charge of this same department store he challenged that summer slump. He was not content to see normal running expenses go hand in hand with an excessive drop in income. As he went about the store he studied the situation. Then he called a conference of all the buyers and put it before them.

"But we expect that," they countered with the same old excuse. "Our best trade leaves the city about June 20th."

"How many people in this town?" the manager demanded.

"About 750,000."

"Phone to some railroad traffic man and find out how many go away," he ordered.

Presently the answer came:

"About 85,000."

"Is it true," the manager asked, "that our business success is bound up in 85,000 people, less than one-eighth of the population of this city? What about the folk who stay at home? What about the visitors who flock to town during the summer months? Can we afford to let a business rest on such an insecure basis? Let's find out where we stand, and why we can't move out of our tracks."

The hunt for facts began. It was a big store with eleven motor delivery routes. These routes were plotted on a city map. The daily delivery sheets for a year back were examined, and the number of packages on each route tabulated and posted in that district. Study of the complete map disclosed the amazing fact that except in July and August three-fourths of the store's sales were made in an area of less than one-fifth the total area of the eleven routes. There was no abnormal summer loss outside of this one very productive district. But here in this area of fat incomes, and social prominence, July and August deliveries fell off nearly 40 per cent from the normal level of other months.

An analysis of the store advertising, both newspaper and circular, showed that the appeal had been directed exclusively to the classes which maintained charge accounts. A "quality" trade had been the conscious purpose: it had been attained with a vengeance. The wage-earning groups, the great mass of people who buy moderate-priced goods had been so impressed with the idea that this was a high-priced store that they were no longer reading the store's advertisements in the daily papers. Long experience had taught them that they could not afford to shop there.

It was determined to reach these moderate-price groups. Their habit of not reading the store's advertisements made necessary some unusual method of approach. It took the form of a large circular, distributed from house to house, featuring the merchandise these prospects were buying at slightly lower prices than they had been paying elsewhere.

What these goods were — what prices people wanted to pay — what values they expected — this was made the subject of serious study. The buyers, good judges of the cheaper qualities, reënforced their knowledge by talks with their clerks about sales lost because prices were high. They even had these clerks canvass the recent purchases, particularly the bargains, of their friends and neighbors. In this way the buying of the trial stock was brought into touch with the needs of the less productive districts.

"Examine these bargains at our store: watch our newspaper advertisements" was the slogan of the circular. The groups aimed at did both. Sales showed an immediate increase. The campaign was begun in July. For that month, instead of the usual loss, the total sales were larger than for May — a condition never before occurring in that store's history. In August the first attempt was made to reach the same people through newspaper advertising. Care was used to feature goods and prices that would appeal. The results showed that the circular had been successful in educating the new group to read the store's newspaper advertising as well as to come in and examine the bargains exploited.

Probing for facts upon which to base new business or reënforce old connections is a policy that may be applied in every business. Initiative, personality and executive ability have carried many an undertaking to success. But no matter what the size or character of the concern, the search for vital statistics must sooner or later be taken up if the business is to continue and not lose ground.

To visit factories in New England, department stores in Missouri and Canada, insurance offices in Illinois, real estate offices in New York, to analyze incident after incident where this policy of building on facts has been the making of a business, would

mean the cataloguing of so many prosperous concerns. Once a merchant or manufacturer sees such an inquiry under way, he accepts the advantages as self-evident and finds that the working out of a program of investigation and analysis is a problem no less interesting than the test of the policy itself.

Business men with the new point of view do not take anything for granted. They look behind results for the hidden causes. As often as not they learn that decreasing sales are due, not to short crops or industrial slackness, but to fundamental changes in marketing conditions or changes in consumer demands which have been accepted as fixed and stable for a score of years.

Old channels of distribution, they discover, have been broken down in many lines. The jobbing house has been eliminated as a factor in many territories, while in other fields, for other products, the wholesale units have been multiplied and their individual size reduced. The consumer demand for certain commodities has almost vanished in fields formerly productive.

After gathering and classifying his facts, the manager frequently discovers that to maintain his accustomed volume of sales, he must either transfer his attention to other groups or classes of consumers or develop brand new uses or appeals for his erstwhile staple goods. Occasionally too, searching inquiry uncovers a general loss of confidence due to lowered ideals or negligence in the handling of orders and customers which has been wholly unknown to the head of the business. Or any one of a hundred other special conditions or circumstances may take threatening shape in the department of his business where he felt himself more secure. The main point to remember is that analysis of the chief functions of any business and the machinery and organization which serve those functions rarely fails to pay its cost over and over again.

How conditions may be analyzed and the facts thus sifted be utilized is illustrated by the recent experience of one great industry. By reason of its size and unquestioned leadership, perhaps, it had developed a blind side in its outlook on the selling field. The momentum gathered in half a century carried it along at about the usual rate of progress. In view of the general slackness

of the whole industry, it was agreed that the company was more than " holding its own."

The president, however, had noted various indications which he felt were more than symptoms of a temporary stagnation. From his reports, he gleaned here and there figures which suggested a slow but decided downward movement in the volume of sales by territories. The growth of the country was holding the total up to the normal mark, but there was evident a sluggishness which could not be explained by lack of quality or value in the goods or lack of energy in the selling force or in the company's advertising, general or direct. The whole trade seemed sick.

Called into council by the president, the directors made light of the situation. At each succeeding meeting, however, as they faced the accumulating evidence of lost ground they began to share his doubts. As they failed to lay finger on the reasons for the recession, their confidence in their own judgment weakened. They felt the adverse undercurrent, but lacked definite information either to reassure them or to confirm their fears.

Finally, the president brought matters to a focus.

" It's time," he said, " to stop this traveling around in circles. We've got to quit guessing and go after the facts. We need a thorough investigation into all the conditions surrounding our business and the tendencies which seem to be turning the trade upside down."

One of the directors objected. Hadn't the auditor smothered them with figures showing forty different conditions which, in the end, turned out to be negligible so far as their influence on sales went?

" Yes," the president agreed, " and that is why we are thinking in circles. We have lived too close to this business, and fed ourselves too much on mere office statistics. We need perspective. We need to see this business in relation to other lines of trade and general consumer conditions. We have been explaining the fluctuations of our trade by all kinds of rough-and-ready reasons — the effect of consolidations, tariff tinkering, the political situation, and so on. But we haven't one shred of scientific fact to back up our explanations.

"We have got to dig into this thing hard and deep. There are several vital things we do not know about this business. We know who our jobbers are and the names of our larger dealers. We write to many of them every day and our salesmen visit them regularly. But we don't know who buys our products for use or what kind of men and women they must make good for.

"Years ago we put our trade in the hands of the jobbers. Retailing has changed but we don't know how it has changed or how the changes have affected our products. Consumer demand has changed: we need to know why and how. I propose, therefore, that we make a broad, thorough, analytical investigation into all these things and try to reduce the information to figures and charts and reports which we all can understand. Then we'll be in some sort of shape to save the business."

The work began next day. First a conference of all the manufacturing executives was called. In company with the president, they sized up the production situation from every angle. They examined the goods from the point of view of salability, value, efficiency, safety in use. But a searching analysis of trade reports, salesmen's complaints, the results of technical investigation and comparative tests established nothing except that the goods were sound. Then followed a series of conferences on the quality and efficiency of products as compared with competing lines. Every consumer's complaint received in ten years was gone over in detail. But no flaw in the sales value of the goods developed. Wherever the sick nerve was, it could not be found in the factory.

Interest centered next on the sales organization and the fundamental selling situation. A study of the whole industry was first made. Graphic charts presented the volume of business of the six leading companies. They pointed back forty years. Getting the sales figures of two of these companies was easy; the other three guarded their statistics jealously, but sufficient data were secured to make the final estimate one very close to the actual figures. This sales chart showed conclusively that there had been no decrease in output which other firms had not felt more keenly; while the ratio of increase was always greater for the company than for the other concerns. In a word, not one firm, but the

whole industry, was suffering the same sickness, whatever that might be.

For the moment, therefore, the investigation did not take up the individual efficiency of the sales staff and organization. Instead, it followed the lead pointed by the sales chart for the whole industry, and tackled the broader questions of the consumer's attitude towards the line, his need of such products and the general distributive situation.

Here a careful investigation was necessary. The information likely to be found useful and suggestive was classified and the inquiry was pushed in all parts of the country. Six weeks later this information, tabulated and reduced to graphic charts, was laid before the executive board. It supplied clear and unmistakable reasons for the condition which they had felt, but had failed to analyze and offer data comparing the current trend of the industry with the movement in other lines.

In a nutshell, the peculiar situation in the trade hinged on three separate developments: The first and by far the most important was the movement of population to the cities and the decrease of wild and uncultivated land. When a man moved in from the country to take a job in a store or factory, his use of the company's products virtually ceased.

The second development was the passing of control of distribution from the hands of the jobbers in the central markets and the multiplication of smaller wholesale houses to which the carrying and pushing of the company's line might be a matter of only casual interest. If the goods were called for, they would be supplied; but a consumer's demand was the only reason for stocking and handling them which these new houses recognized as imperative.

The third transformation which had taken place in the distribution field was the entry of the department store and the mail order house into a field which had always been controlled exclusively by dominant specialty dealers in every town of any size throughout the country.

To arrive at these conclusions thirty or forty graphic charts were compiled.

The per capita consumption of the whole industry's products was a long and tedious job. In some territories the books of the leading wholesalers supplied the necessary information, eked out by estimates covering the volume of those jobbers who were not in sympathy with the purposes of the inquiry. In many cases it was necessary to draft local correspondents, banks and commercial agencies into the investigation.

It was not easy, from this somewhat formidable mass of matter, to arrive at conclusions which would give a real insight into conditions. The figures on which the graphic charts were based would have discouraged and possibly baffled the executives, whereas the graphic charts brought all the information into coherent and recognizable relation. One by one the conclusions projected themselves out of the information gathered and satisfied even the most skeptical. Instead of guessing that the increasing tendency of the population was toward the city, and that the gradual elimination of forests and other uninhabitable places was one big factor in reducing the consumption of the company's goods, the graphic charts not only corroborated this theory completely, but *measured* the exact extent of the relation between cause and effect.

On the main issues all agreed that the evidence of the charts was conclusive. The falling off in sales for the whole industry was due to the changed attitude of the consumer, coupled with the general indifference of the wholesaler and the lack of an incentive to coöperation on the part of the dealer.

This conclusion indicated as plainly as a " graph " itself what would have to be done to restore sales vigor and efficiency. Constructive educational work was necessary to revive the interest of the urban consumer. His changed situation had to be taken into consideration in framing the new appeal. New uses had to be discovered and pointed out. Many of the products would need adapting to this changed physical situation.

The consumer's wants, desires and opportunities to use the company's goods furnished the key to the situation. The wholesaler's indifference would yield to the revival of consumer demand and the right kind of selling effort. Where he failed to show the

proper interest in the new sales plans, the company had a second string to its bow. It could either transfer the account to another jobber more amenable to influence or deal with its retailers direct.

In any event, the coöperation of the dealer was so necessary in exploiting the product, in effective use of local and direct advertising and selling helps and in the final man-to-man trading operation that the wholesaler, as a factor in sales, dwindled in importance as basic conditions in distribution became clearer and better understood.

The advertising manager, in touch for the first time with the environment and needs of consumers, was able to plan a campaign which would turn the attention of these forgetful buyers again to the company's products. Knowing where the various classes were grouped, he was able to choose mediums and vary appeals so that each dollar spent earned its right proportion of inquiries and orders. His campaign directed at retail dealers had the same virtue of shooting at a mark made visible by the light of exact knowledge.

The sales manager, in his turn, found the board of directors a unit in backing up the vigorous program he laid out for handling the jobbers and coaxing his dealers into line with the new program of coöperation. Even on the negative side, the investigation was not without result. The works' superintendent, who had been urging an addition for two years, after studying the "graphs," acquiesced in the board's decision that for three years every surplus dollar was worth double its factory value if expended in the selling field.

This particular business has not yet solved all of its marketing problems. It has, however, made a fresh start on a well-mapped road, with an organization full of confidence in its policies and its managers. It is meeting its trade problems and tendencies intelligently and is gathering strength and experience in the new program and methods, while its rival companies, without definite knowledge on which to base their efforts, are piling blind enthusiasm into a widening breach.

IV. Demand Among Owners of Homes [1]

Manufacturers and advertisers who are anxious to analyze the possible market as definitely as may be are likely to be aided materially by a line of research which has been undertaken by the national Government and which is, in great measure, new to Federal statistics. This investigation, which is being conducted, primarily, by the United States Census Bureau, is designed to show what proportion of our population, in town and country, occupy their own homes, and also what proportion of the owned farms and urban residences are free from mortgage.

It is probably well-nigh superfluous to dilate upon the influence of home ownership upon merchandising conditions, and yet it is suspected that there are many distribution and sales interests that have underestimated the weight of this factor in consumer demand and some that have overlooked it altogether. For instance, there are some advertising and sales managers who, while admitting the significance of home ownership in the case of that large and growing consumer class that buys on the instalment plan, have been loath to concede that this consideration enters in with respect to ultimate consumers who purchase for cash through either mail-order or retail channels.

A more far-sighted policy perhaps is that of the advertisers who have been impelled to study this and all kindred subjects because of a realization that there is no telling to what lengths the "easy-payment" system of selling will ultimately extend. Originally confined, for the most part, to more or less expensive necessities, such as sewing machines, it has rapidly extended to all manner of luxuries and, as a straw that indicates the trend of the wind, we have the prediction from authoritative sources that a few years hence will see the instalment plan obtaining in the sale of as large a proportion of the automobiles marketed as it does now in the piano and player-piano line. And, just in proportion to the elimination of the jobber and the extension of the scheme of selling to the retailer direct, will all the problems of instalment-plan selling be brought home to the manufacturer.

[1] *Printers' Ink*, October 23, 1913, pp. 62–68. Reprinted by permission of *Printers' Ink*.

Home ownership has, however, a wider and more general significance than as a test of the financial responsibility of individual prospects for instalment-plan selling. It would seem as though a study of the statistics which will ultimately be available covering the geographical distribution of homes owned, the proportion of the properties free from incumbrance, etc., etc., could not fail to afford a worth-while key to market possibilities. And these selfsame statistics will contain many surprises that should have very tangible value, especially for those advertisers whose policy it is to localize their campaigns in one way or another.

As has been said, this line of investigation is, for the most part, an innovation. To be sure, some effort was made in taking the census of 1890 to obtain data of this kind, but the plan was limited in scope. In connection, however, with the recent census, information on this score was obtained in all parts of the country and covering all classes of the population. Already the Government has completed its investigation as to the ownership of farms. And conditions on this score in the rural districts are, if anything, more significant and more representative than the corresponding status in the cities.

One of the surprises above referred to is found in the lately completed farm statistics. We have heard much in recent years as to the rapidity with which prosperous American farmers are supposed to have been clearing off the mortgages on their land, and yet these new statistics show that a larger proportion of American farms are mortgaged than was the case ten or twenty years ago. The officials who have compiled these figures emphasize, however, that mortgage indebtedness is not necessarily an indication of lack of prosperity. Although in some cases mortgages are placed on farms because of poor crops or mismanagement, such obligations more often represent an unpaid portion of the cost of the farm itself or money expended for additional land, for new buildings or other improvements and for other equipment.

Following this same line of argument to the effect that the existence of a mortgage, under right conditions, indicates an ambitious and progressive citizen, it might be pointed out that in

some respects the owner of mortgaged property constitutes the ideal prospect for the manufacturers of many lines of advertised goods. The mere fact that such an individual has a mortgage on his farm or residence property implies a certain willingness to purchase on the instalment plan. He is presumably a convert to both the theory and practice of instalment buying, and in order that he may be sold on any proposition, it is only necessary to convince him that his comfort, his material prosperity or his mental or physical welfare will be sufficiently well served to justify incurring the responsibilities involved.

It is a question, after all, whether the man who, though having a dependable but modest income, is wedded to the habit of purchasing for cash is not just about the most difficult possible proposition for the firm that is placing goods that command prices in three figures. That very system or fear of debt which impels such a man to always pay cash bespeaks a frugality which causes him to hesitate a long time before he will lay down the sum (say several hundred dollars) necessary to purchase outright a pleasure vehicle, a musical instrument, a reference library, art objects, ornamental furniture or any other one of the dozens of advertised products that allure the average household. What appears to such a man an almost reckless extravagance when measured by the cash outlay might be regarded in an entirely different light if tempered by the monthly-payment plan. It is possible, therefore, that many interests in the advertising world can derive maximum benefit by studying Uncle Sam's new statistics not merely to locate home owners, but to determine where the greatest percentage of home owners are willing to place mortgages in order to make desired purchases.

And in support of the contention that this is sound logic, it may be pointed out that the farm statistics just compiled show that the proportion of mortgage indebtedness is higher in Iowa and Wisconsin than in any of the other States, and yet these States are among the most prosperous in agriculture. Or, again, take the fact that the most conspicuous increase in the proportion of farms mortgaged has been in the southern part of the country. This increased activity in borrowing in Dixie bespeaks as plainly

as may be an increased confidence on the part of lenders in the titles to land and in the ability of the farmers of the "New South" to pay their debts. Now, of course, advertisers have not waited for this intimation to prod them to cultivate the Southern market, but it is worth something as adding to an accumulating weight of evidence to one end.

Taking into consideration the entire United States, it is found that the proportion of mortgaged farms in relation to the whole number of holdings increased from about 28 per cent in 1890 and 31 per cent in 1900 to more than 33½ per cent in 1910. Of the nine geographical divisions in which the country is apportioned for statistical purposes every division showed an increase in mortgages during the first decade of the century except the Middle Atlantic division, which is made up of the states of New York, New Jersey and Pennsylvania.

But there is another side to this story, and it concerns the marked diminution during the past twenty years in the relative importance of the mortgage debt carried by our farmers. Thus, though the proportion of farms mortgaged has increased, the latter-day prosperity of our tillers of the soil and the rapid increase in the value of farm land has caused a sharp decline in the ratio of debt to value, which is given as only 27 per cent at the present time, as compared with more than 35 per cent a score of years ago. But it is no mystery that the average farmer's quickened buying propensities have not by any means kept pace with his increased purchasing power. To facilitate the deadly parallel, it is only necessary to point out that whereas mortgage indebtedness per farm increased on the average from $1,224 in 1890 to $1,715 in 1910, the average owner's equity per farm mounted in the same interval from $2,220 to $4,574. In other words, it more than doubled. The detailed figures show that this increase in buying power has extended with a reasonable degree of uniformity to almost every state in the Union.

While those farm figures relative to indebtedness and value, which may be translated as purchasing power, show so gratifying a trend, it is also notable that there is only a slightly less satisfactory state of affairs on the basis proposition — namely, the farms

or farm homes operated or occupied by owners. In the United States as a whole substantially five-eighths of the farms are operated by owners, and the remaining three-eighths are in the hands of tenants. It is worthy of note, however, as indicative of a marked tendency, that during the past ten years the farms operated by tenants increased much more rapidly — twice as rapidly, in fact — than those operated by owners. The percentage of increase in the case of the former was 16 per cent, as compared with 8 per cent in the case of the latter. This is no new manifestation, however. Ever since 1880, and probably from an even earlier date, the farms operated by tenants have, in each decade, increased faster than those operated by owners. Just what bearing the current "back-to-the-land" movement will have on this tendency is bound to be watched with interest by many advertisers.

There are in some sections of the country proportionately more farms operated or occupied by owners than is the case in other districts — this being a point not to be overlooked by those selling to rural consumers. Throughout the South, for instance, there is a high proportion of tenant farmers, the proportion of tenant farms exceeding 50 per cent of the total in the greater part of Dixie. There is also a comparatively large proportion of tenant farms in such states as the Dakotas, Missouri, Minnesota, Iowa, Kansas and Nebraska. On the other hand, there is a minimum of tenant farmers in New England, and there is a small percentage of such farmers on the Pacific Coast and in the Rocky Mountain states. It is interesting to note that throughout what is commonly known as the Middle West, perhaps the most important farming section of the country, and in all parts of the South, the tenant farms formed a larger proportion and the farms operated by owners a smaller proportion of the total number of farms in 1910 than in 1900, but the opposite is true in New England, on the Pacific Coast, in the Rocky Mountain country and in the states of New York, New Jersey and Pennsylvania. Shall we construe it that these districts are the chief objectives of the "back-to-the-land" crusaders?

The proportion of home owners among the farm population will doubtless be closely compared with the percentage of home owners

among urban residents when figures are obtainable indicative of the latter. On the face of it the comparison will presumably be very favorable to the rural market and will doubtless be made the basis for many arguments on the part of those who contend that a home owner is the best prospect for many classes of advertised articles. As a matter of fact, there are two sides to the question, and the varied and insistent advertising appeal and superior merchandising conditions of the city must be taken into account; but, nevertheless, it is a dominant fact that the average individual will take more interest in furnishing and ornamenting a home which he owns than one which he rents, and there are many persons who hesitate to acquire any more bulky possessions than are absolutely necessary so long as they occupy rented quarters with the prospect of a removal once a year or oftener.

It is certain, too, that the proportion of home owners will be shown to vary tremendously in different cities. Communities made up of detached houses, such as are found to so large an extent in Detroit, Cleveland, Indianapolis, Buffalo and other cities of like character, will show a much greater ratio of dwellings occupied by owners than will those Eastern cities where the vast majority of the population reside in hotels, flats and apartments. In the case of the latter communities — and even with respect to cities such as Pittsburgh and Los Angeles — full justice could be done in the matter of home ownership only in the event that it were possible to embody with the statistics of the city proper the figures for surrounding suburbs.

Even if it be open to argument whether it is easier to sell to a home owner than a renter or whether the one is a prospect more worthy of cultivation than the other, it must be conceded that the home owners are the more readily reached with certain forms of advertising appeal — notably the booklets, circulars, catalogues, etc., that are distributed by mail. Home owners move much less frequently than renters, and consequently a mailing list gains in permanency and dependability just in proportion to the number of names of home owners it contains. Similarly, the tastes of the home owner are likely to be better known by the neighborhood tradesmen, and this is sometimes a factor in demonstration work

at retail stores and in securing an introduction for new products. Finally, the home owner is personally in the market for many articles, such as screens, paint, seed, stoves, window shades, etc., to which the renter pays little direct attention.

V. Planning Next Year's Business[1]

By Melville W. Mix

We all know that at the end of next year we can look back, figure up the total business we have done this year, the profit we have made. But we don't realize that the volume of next year's business and especially the amount of next year's profits depend on how accurately we are able to prejudge the coming year's business, plan it and prepare for it. For years I have made it part of my organization work to plan next year's business. Organization work, I say — for to lay out accurately and effectively the coming season's business requires that the organization and systems of the concern be such that they will adapt themselves to this purpose. Sales and factory organization, sales records and reports, cost systems and stock systems, selling methods and shop practice — must all do their share in making the look-ahead possible.

That an accurate look-ahead is possible — that next year's sales can be determined in detail and prepared for, that the factory's work can be laid out and scheduled — I have proved to myself time and again. It was this system that enabled us to see the stringency of two years ago twelve months ahead, and consequently to adjust our business accordingly. It was this system that told us just the appropriate time to launch our general advertising campaign, and so increase our sales thirty-eight per cent.

Planning ahead for the coming year cannot start the last month of this year. It must be begun years before — a quarter of a century in our case. For a planning-for-next-year system must have the most accurate basis: figures — cold, hard, mathematical figures; and facts — proved, recorded facts.

[1] *System*, September, 1909, pp. 253–259. Reprinted by permission of *System*. Illustrations of forms are omitted.

Our records of business run back for twenty-seven years; definitely tabulated as to sales by territories and lines of goods; as to production by costs and stocks on hand.

That is the basis of our prophetic powers. Like the source of most things that look like genius, it is just — knowledge.

Our fiscal year ends December 31; the stockholders' meeting comes in February. During the intervening month we put into definite shape our plans for next year. These plans fork in three directions: we determine next year's sales and lay out the selling campaign; we study our manufacturing facilities and see that the factory has capacity to turn out the sales quota; we plan for expansion — new lines of manufacture, new facilities for increased output.

Planning ahead means first determining probable sales. For selling the goods is the last step in the process of manufacture, but the first is determining the amount to manufacture. No wisdom lies in preparing to make what can't be profitably sold.

The figures of last year's sales are the basis for judgment of next season's business. These figures are so tabulated that I know the exact sales made in each territory and through each agency, by lines of goods and by periods. Our goods are sold through two hundred and forty agents covering the whole country, through salesmen in our branch houses in the large industrial centers, and through salesmen working direct from the home office. Our sales are classified into thirty-eight different lines and are recorded under thirty-eight corresponding sales accounts.

A record of our sales is kept for each one of these various sales units classified according to these thirty-eight accounts. The first source of our records is the orders as they come in from the various agents and salesmen. These orders are classified and tabulated until they finally reach me in a concentrated form. One sheet is given to the record of each sales unit for one month, classified according to the thirty-eight sales accounts and tabulated so as to show comparisons with the previous month, with the same month the previous year, and with the total of the current and the previous year. The sheets for each sales unit are bound together in a pamphlet so as to bring together a complete record for a year.

The sheets keep me informed of the exact conditions in every agency and in every territory and of every line of goods. I keep track of increases and decreases in the sales of agents and of the sales of different lines. I can follow exactly the tendencies in the different territories and in the different lines.

But the figures alone do not tell the " why "; they show what is going on but they do not show the reasons. So another source of information is necessary — information concerning business conditions, concerning developments in our trade and among our customers, concerning the circumstances and methods of our selling agents, concerning the circumstances that surround each transaction and each development in our business.

This nebula of facts and of human interest which envelops the selling end must be taken into consideration in judging the possibilities of business for next year. This information I glean from sales reports which come in every day from our salesmen and less frequently from our agents, from various mediums of trade news, from personal observation and letters and from special reports.

Especially do I watch the causes that lead to an increase in the sales of any line of goods in any territory, for in planning next year's work I must know whether these conditions are going to continue and whether the conditions and methods that have brought about the increase cannot be duplicated in other territories and in other agencies. For it is not enough for an executive head to arbitrarily lay down the volume of business for the coming year; he must mark out the lines and plan the methods that will bring this amount of business.

With these sources of information then — the figures of previous years' sales and the knowledge of trade conditions — the next year's sales quota is determined. Each unit of the organization is taken up in turn. With the comparative figures of previous years' sales before me, I call to mind the conditions in this territory and in this sales unit, determine what pressure for additional sales can be brought to bear, estimate what the conditions the coming year will probably be; then I determine what increase all these factors are likely to bring and set a sales quota for this unit.

After all, I regard the most important point in planning next year's work to be not the *determination* of the sale's quota, but the laying out of the actual *methods* we will pursue to help the agent sell his quota. Because much of our business is handled through agents, the agency is the first source of next year's business to be studied.

One of our special sources of information on the agent is an agency record, kept apart from the general sales records, where the facts regarding each agent are recorded. This card indicates at a glance what the agent's quota of sales has been for several years, how close he came to selling this amount, what the conditions in his territory have been and any further general facts regarding him. The record also shows the definite aid in selling given him by the house — such as local advertising, circular letters, advertising literature — and what the cost of this advertising amounted to.

Now suppose we find from our records that we have sold a particularly large amount of some line in a territory. We find out the reasons, the methods by which these sales were made; if these can be duplicated we tell our other agents about them and we estimate how big an increase in their sales they should bring. If a certain line of local advertising or circular letter work that we have done for one agent has proved successful, we duplicate it among other agents. If certain goods have proved particularly profitable we give agents special methods for pushing them. And all these cases affect the quota finally determined.

Local conditions, of course, often govern big sales; they must be considered in the agent's quota. Certain local changes during the past year may have raised sales to a point which cannot be maintained; new conditions about to materialize may greatly increase the possibilities of sales.

Enthusiasm and prestige I consider definite bases for increases in the sales — provided that enthusiasm is instilled into agents and our prestige is brought to their realization. We strive to awaken in the agent himself the desire and the initiative to increase his sales. This is one of the functions of our publicity advertising, of our house organ, and of our agents' conventions.

And particularly we are always pointing out to every agent that the very fact of his being our agent is an asset to him; and that this asset appreciates in value as his sales increase. Many a time have I told the story of the specialty agent in New Orleans who, when he sold out his business and inventoried his stocks, fixtures and so on, added an item for prestige, $50,000 — and got it. And the good-will of an agency is nothing more than the combination of his own prestige and the prestige of the manufacturers whose goods he handles.

With the sales quota determined in detail, the manufacturing quota for the year is easily fixed: it is simply the sum of the thirty-eight lines of stock, totaled from the sales-unit sheets. Manufactured stocks are carried in the records of the manager of manufacture under the same general groupings as in the sales accounts. Subtracting stock on hand from the sales quota of each line, therefore, tells the quantity of each product to be manufactured during the coming year.

This quota is, of course, not followed blindly by the factory; it serves rather to point the *direction* that next year's production will take. Its greater value lies in the basis it affords the manager of manufacture for systematizing his factory practice and reducing his costs.

So far as actual manufacturing is concerned, the schedule is handled flexibly. The manager of manufacture does start his production on the basis of the quota which the sales department has planned for. But he does not work far enough ahead to be caught unawares by any variation in actual sales from quota. He accomplishes this by means of an inventory and stock order system, which gives him a firm grasp on production. He really schedules his work on the basis of three facts: last year's orders for the same period, the total of orders as they are coming in from day to day, the expectation of sales as they are shown by the quota.

His sole object is to manufacture enough stock to keep sufficiently ahead of the sales demand that he will not be caught under-stocked, and yet not build on estimates so far ahead that there is liability of over-stocking.

The summary cards for stock orders are like those for sales. These summary cards are filled out every two weeks, so that instead of planning his work for six months or a year ahead in the way that the sales department must plan, the shop superintendent in working out in detail the plans of the sales department makes new plans practically every two weeks. Consequently, if some lines of goods in which a big sale is anticipated fail to meet expectations, no huge stock of that particular line of goods is on hand to be carried over into next year.

No maximum and minimum stock is fixed. The sales on a particular item for the year before are scheduled on a finished stock card and the orders for stock are made out in the superintendent's office on the basis of the relation between the perpetual inventory kept there on the stock card as it varies from month to month in its relation to the sales quantity of the previous year.

The manager of manufacture watches the stock accumulation at two points — after it leaves the foundry and is stored as "rough stock" and after it is machined and held as "finished stock." Two sets of stock inventory cards corresponding to each item in stock are kept by four clerks in the superintendent's office.

In handling rough stock and finished stock a definite relation is maintained between the total quantities of each pattern on hand. One of the methods adopted to hold this stock to the minimum and yet be able to meet sudden demands for goods is to standardize parts as completely as possible.

But the real planning ahead that the manager of manufacture does, in which and for which the sales quota affords him the basis, is in determining what the general line of his manufacturing for the coming year is to be, what capacity he must provide for, what equipment he must have, how he can standardize stock and operations, and where, taking all these elements into consideration, he can cut costs.

If he knows that he will have, say, ten thousand of a certain part to make next year where he had one thousand last, he has an entirely different problem of department arrangement, machine

equipment and organization; and there are opened up to him possibilities for cost reduction that the previous smaller volume has not allowed.

As far as possible the product is standardized, not only to cheapen the cost of manufacture but to give better service to customers.

Detailed improvements in machinery cannot be minutely planned. General consideration of reducing the cost of certain lines can be made, however, and then worked out in detail under circumstances as in this case. This constant study to reduce the cost of manufacture is based, like our plans for next year's sales, on past records.

Besides laying out a definite sales and manufacturing campaign, the question of expansion always has to be considered when next year's work is planned. Expansion follows lines of least resistance. Sometimes service to a customer suggests a line of equipment which might profitably be fitted into the sales and manufacturing campaign. General tendencies in business often open up new possibilities. A class of manufacturing may have been at a standstill for a decade. Then some big, new development will come which will make a market for a new specialized equipment. For several years there have been few if any new flour mills. There is only enough new material to supply a maximum number of factories, and this number has practically been reached. And as our product deteriorates little in use, there is no big demand for new equipment to replace old; so when no new factories are going up the demand for our product falls off. But electrical development has taken place. Hydro-electric instead of steam power has made possible a lower cost of manufacturing and, consequently, mills are being overhauled and re-equipped. Here is a condition which must be watched for, a tendency in manufacture which means more business in the future. It is dangerous to determine on a marked increase in the sales quota without providing a corresponding increase in production facilities.

Expansion, then, cannot be made the moment the increased quota is determined, but the plans should be laid and the way

smoothed so that when the increase does come facilities can be expanded rapidly. For additional orders are turned into a loss rather than a profit when production in the plant must be overstrained to handle them.

VI. Sales Development[1]

In some organizations it takes a long time to discover the little deserts on the territorial map of sales, and, when found, ordinary methods of irrigation often fail to make them productive.

Some concerns accept a known selling weakness in certain sections as one of the inevitable results of competition. Others are not so easily pacified. They want to know why, specifically. If the desire for knowledge is strong and persistent the answer is usually found, and with it the remedy.

Several years ago a representative New England shoe house installed a new sales manager. His predecessor in that capacity was a member of the firm who found it necessary to unload some of his growing executive burdens.

The business had grown steadily and no special need of greater selling efficiency was apparent at that time. The firm employed about fifty salesmen — a force that supposedly was covering the whole country. It was expected that the volume of sales would continue to grow through a natural individual development among the salesmen.

But the new sales manager brought with him a fresh viewpoint that was not molded and hedged in by the precedents and established methods of the firm. He also possessed an inquiring mind, so he began to analyze the sales policy and check up results in a definite way.

While his use of maps and tacks in spotting sales will not be news to most sales managers, the manner in which he employed these devices to pry salesmen away from jealously guarded territory without hurting their feelings overmuch is likely to prove suggestive.

One of the first things that the new man did was to study the individual territory of each salesman — estimate what it should

[1] *Printers' Ink*, April 1, 1915, pp. 3–8. Reprinted by permission of *Printers' Ink*.

produce in sales for his house, and compare this result with what was being produced.

In order to do this intelligently he procured a map cabinet and a set of state maps. Now most concerns whose policy it is to designate a route for their salesmen use a map system for that purpose, but many concerns depend largely on the initiative of their salesmen in this and many other respects, and judge their efficiency on aggregate results. The firm in question had followed the latter method, and territory had been allotted largely by states, so a map system had not been considered necessary.

But this sales manager found other uses for a map record — first he carefully drew the boundary lines of each salesman's territory on the maps wherever more than one salesman worked in the same state. Then he prepared a list of every town of five hundred population and over in each territory. That was the range of towns in which the goods could be sold profitably.

These lists were then compared with the sales records, and each town checked to indicate whether the house sold any goods there.

When the lists were completed they told an amazing and very interesting story. The average salesman was selling goods in only about half the towns in his territory.

At one stroke the new sales manager had uncovered a vast field for sales development.

He analyzed it more closely. First he transferred the information given in the lists to the territorial maps by using a green-headed tack to designate every town where the company sold goods. Red-headed tacks were used to indicate the no-sale or opportunity towns. The maps then presented a comprehensive picture of each salesman's territory. The weak spots stood out in the limelight — a surprising number of them.

Why? How can they be eliminated? These were the next questions.

The lists were revised to show a more complete story, which included the population of each town, the names of all well-rated dealers in each town, and the exact amount of sales to each customer during the preceding year. These facts, when assembled, disclosed other valuable information. They brought to light

special weaknesses of various kinds in individual salesmen. One salesman's record, for example, showed no sales whatever in towns of less than 5,000 population. Evidently he passed up smaller towns entirely. Another salesman seemed to take the opposite course. His small towns were nearly all well developed, but he secured very little business in the large cities. It was noticeable that some men almost invariably secured their orders from concerns whose commercial ratings indicated them to be the smaller stores in a town. In fact the lists and the maps together provided an excellent bird's-eye of what each salesman was doing in his territory.

Of course it was not safe to rely altogether on this information, because there are influences and local conditions which cannot be visualized accurately from a private office. However, here was a basis for constructive sales development — and more intelligent supervision of the salesmen.

A copy of the list pertaining to his territory was sent to each salesman, together with a letter directing his attention to obvious conclusions.

The letter was not in the form of a reprimand, nor did it contain any definite instructions that would be construed as a positive order. It pointed out the opportunities of the salesman to increase his sales by more thorough application along certain definite lines. Furthermore, each salesman was told that the house was going to conduct a special direct mail campaign to interest every well-rated dealer in every town where he was not selling goods.

The inference of course was that he was expected to call on those dealers.

This had a distinct moral effect on most of the men, as they realized for the first time that their work was being closely watched in the house.

Many of them took the cue and succeeded in opening some nice new accounts.

Also, the mail campaign stimulated a good many inquiries which forced them to call on dealers they had never solicited before.

As a matter of fact, however, it developed that most of the salesmen had too much territory — more than they could work thoroughly. Naturally they had hit only the high spots at first, and gradually settled down to devoting most of their time to regular customers. The sales manager arrived at this conclusion as the first season drew to an end, because the red-headed tacks were still very much in evidence on the maps.

Here was a problem that required some thought. It meant putting on more men. The only way to make room for new men was to take territory from old ones — and the average salesman is jealous. A closer study of the maps and the red tacks helped to solve this problem.

One example will illustrate what was discovered and what occurred in most cases: The territory of one salesman consisted of the whole state of Georgia. He lived in Atlanta and made that city his headquarters. If you should draw a horizontal line through the center of the state you would find that Atlanta is located nearly in the center of the upper half. The tacks on the map of Georgia showed that this salesman got most of his business in the upper half of the state. In other words, he spent most of his time near home, and even in that section there were more red tacks than there were green ones in the lower part of the state.

It so happened in this case that another salesman, who was a prodigious worker, had found the state of Florida too small to occupy all of his time. Consequently a slice of southern Georgia was taken from the Georgia man and given to the Florida man. The Georgia man kicked like a steer, at first, but gave up when he was shown that the business he really lost by the transaction was hardly enough to justify the time and expense of getting it. He was also shown a lot of red-headed tacks in the remaining part of his territory.

During the next season both men increased their sales — the original Georgia man about $10,000 with less territory, and the Florida man got about $20,000 out of his new Georgia territory.

But, when the sales manager checked up those tacks on the map again he found almost as many red ones in the original

Georgia man's territory as there had been at the beginning of the season. He also observed that most of them were grouped in one section. He ruled off that section, and then figured the amount of business the salesman would lose if he took it away from him. It amounted to about $5,000. Then he figured the possibilities of the entire section and found it sufficient to support a salesman of average ability. He submitted it to a promising applicant who lived in the section, and it was accepted.

The original Georgia man was displeased again, but he didn't show much fight. The red tacks and the figures didn't leave much ground for him to stand on. He said the new man would starve to death and the territory would come back to him in six months.

But it didn't. The new man sold almost as many goods as the old one did, and the latter registered another small increase in sales the following season.

Moreover both men have continued to increase their business, and today Georgia yields to that firm over three times the business it did before the red tacks were put on the job.

The Georgia experience was repeated with slight variations in a good many other states. In some cases the new men developed into better salesmen than the old ones. The original force of fifty men has been increased to eighty-five, and there was only one of the old men who decided to quit rather than give up any of his territory. He was allowed to take his choice and he has wanted to get back ever since.

In working out this plan, great care was taken to be fair and just to the old men. No territory was taken from any man who could and would work it satisfactorily. In some cases they were given an opportunity to demonstrate better results.

Some of them would plead only for the privilege of retaining certain towns where they had established customers. This request was granted in a few instances, but the idea did not work out well. Such towns were usually the best ones in the territory and it discouraged the new man if they were excepted from his territory.

This firm still has use for a few red tacks, but they are pretty well scattered over the maps and usually denote a small town

where few dealers and strong competition make it hard to get a foothold.

The experience of this concern proved that the weak spots in its distribution were due largely to lack of proper cultivation. Moreover, a rather loose sales policy had made it possible for such a condition to exist for some time before it became known. The result was not only a loss of business that could never be replaced, but was also a partial waste of money that had been spent for both trade and consumer advertising.

VII. Need of a Federal Trade Census [1]

By Melvin T. Copeland

The study of domestic trade in the United States is seriously hindered by the dearth of readily accessible information. To facilitate researches in this field there is a need of a federal census of market distributors — dealers in raw materials, commission merchants, wholesalers, and retailers. These merchants make up a numerous and, in general, a necessary class in our population. Their activities affect every inhabitant of the country. There would be a widespread and vital interest, therefore, in the results of a census which would show how many people are gaining their livelihood from trade, the number and size of stores of the various classes, their geographical distribution, and the amount of their business.

Such trade statistics would give enlightenment upon subjects of general and local concern. What is the ratio of retail stores to population? Is the total number or the number of any class of stores increasing relatively faster than population, or is it relatively decreasing? We can only guess. Some cities are primarily jobbing centers; their manufactures are comparatively unimportant. But through a change in freight rates or for other causes their trade and their prosperity may be slipping away. In other cities the jobbing trade is rapidly expanding. But all the estimates of wholesale or retail trade now made are apt to be biased or inaccurate and are altogether inadequate. Reliable

[1] *Quarterly Publications of American Statistical Association*, vol. 15, pp. 62–67. Reprinted by permission of American Statistical Association.

information concerning the volume of trade and the agencies through which it is carried on can be obtained only by a federal census.

The costs of market distribution are by no means light. Many commodities of everyday use, such as cotton cloth, clothing, shoes, and groceries, ordinarily yield the wholesaler and retailer together a total gross profit of at least 30 to 40 per cent of the retail price. Although, as a rule, the wholesale and retail trades are not great fortune makers, the total cost of distributing finished products to the consumers not infrequently exceeds the amount paid for the raw material plus the costs of manufacturing. With a view to economy attempts are continually being made to shorten the route from the factory to the consumer. Traditional market methods are upset. A life and death conflict ensues. Twenty years ago most of the shoes manufactured in the United States were handled by jobbers; now the proportion is, perhaps, one-half and shoe manufacturers have even gone so far as to operate their own retail stores. Textile manufacturers have been dispensing with the services of commission agents. Some manufacturers of goods retailed through grocery stores no longer sell to wholesalers but direct to retailers. "Trusts" have in some instances either ceased to sell to jobbers or have at least restricted the amount of trade handled by that class of middlemen. It was the jobber and the retailer, not the consumer, who felt oppressed by the old American Tobacco Company.

New types of retailers — department stores, chain stores, coöperative societies, and mail-order houses — have, on the other hand, become such large scale purchasers that they have demanded and received jobbers' discounts. As a consequence they can undersell the small independent retailer and threaten his very existence. Before this bitter strife reaches its climax a demand may be heard for restrictive legislation, such as the department-store taxes of the German states. In fact some attempts have already been made to secure the passage of a law prohibiting the giving of rebate coupons in the retail tobacco trade. The question of price maintenance, the right of the manufacturer to compel observance of a fixed retail price, has not been settled by the

recent decision of the Supreme Court in the Sanatogen case. The issue will attract more attention from our legislators in the future than it has attracted in the past. One of the most forceful arguments in favor of price maintenance is that it tends to protect the smaller retailer against the price-cutting policy of the department stores and the chain stores. The results of these changes in marketing methods can, at the present time, be judged only in a general way. We have no reliable statistical information to show how far the changes have gone nor what the actual tendencies are. By giving us facts a federal trade census would enable a more intelligent consideration of the questions of public policy involved.

In order to analyze their markets, manufacturers and large mercantile houses have sought statistics of the number of whole-

NUMBER OF RETAIL STORES

Territory	Drugs			Hardware			Jewelry		
	List A	List B	List C	List A	List B	List C	List A	List B	List C
United States..	43,588	45,176	37,074	30,504	39,446	27,270	21,684	20,145	18,249
New York	2,828	3,965	1,830	2,005	2,636	1,430	1,544	2,132	1,320
Pennsylvania ..	2,342	3,315	2,450	1,576	2,393	1,480	1,504	1,702	1,470
Ohio	1,469	2,099	2,052	2,037	2,288	1,770	1,245	1,163	1,230
Illinois	1,766	2,833	1,787	1,967	2,995	3,320	1,152	1,431	1,101
Missouri	2,518	2,407	2,370	1,367	1,932	1,215	908	836	670
Maine	407	406	*	263	402	*	250	253	*
Georgia	991	1,041	*	313	536	*	309	262	*

* Data not given.

sale and retail stores which could serve as outlets for their goods. To meet this demand, lists have been prepared by several agencies, samples of which are given in the table above. Although in several instances these lists correspond with each other fairly closely, they are, in the main, widely divergent. List A was published in the *Mahin Advertising Data Book*, 1913; List B in *Printers' Ink*, January 18, 1912; and List C, in *Advertising and Selling*, April, 1912.

These are all reputable publications which would not willingly, I think, circulate inaccurate statements. The figures given here

for three trades in seven states are typical in indicating the discrepancies which exist between all such figures. As a brief examination will show, the variations are not uniform. The list with the largest total for the United States does not give the largest number for each of the individual states; note the figures for drug stores in Missouri and for jewelry stores in New York, Pennsylvania, and Illinois. And the list with the smallest total for the United States sometimes has the largest number for an individual state; note the figures for hardware stores in Illinois. Although doubtless due in part to variations in definition, the discrepancies throughout are irreconcilable. This is sufficient answer to the argument that the collection of such information should be left to private investigations. In a federal census the definitions would be standardized and the statistics more accurate. The information thus provided would be of distinct help to business men.

The only attempt at an official collection of such trade statistics was made in the Massachusetts census of 1905. The schedule was simple but included several of the questions which should be asked in the proposed federal census. No serious difficulties were experienced in the collection of the information. Nevertheless the results as published have little worth. Largely because of the urgency of the work on the population and manufacturing censuses, which had the right of way over the trade census, the classification and tabulation of the trade statistics were not satisfactorily carried out. This was shown most strikingly in an incongruous combination of wholesale and retail figures. Despite its non-success, however, the experiment does not indicate that there are any insuperable obstacles in the way of a federal trade census; on the contrary, it makes the proposal appear more practicable.

It is to be frankly recognized that, as in other census work, nice problems of definition and classification will be encountered. There will be omissions and duplications, as in the manufacturing census. In the *Abstract of the Thirteenth Census* (p. 514) it is stated that: "The figures for some industries do not represent the total production, because important establishments that

manufacture the same class of products may be included in other industries." Other qualifications are appreciated by all who have had occasion to analyze carefully the census statistics. Yet the results are generally accepted as approximately correct, and the percentage of error would probably not be higher in the trade census. In filling out some of the schedules for the trade census it might be necessary to accept estimates, but it is doubtful if this would occur as frequently as in the agricultural census.

Under present conditions and with the type of enumerators which must be employed, it would be a hopeless task to try to secure statistics of costs of store operation. The accounting systems of large establishments are diverse, and many small stores have only a haphazard system of bookkeeping or none at all. The Bureau of Business Research of the Harvard Graduate School of Business Administration found it essential to prepare a uniform system of accounts before it could obtain comparable figures for the costs of retailing shoes. Hence, whatever the federal government may eventually do in this line of investigation, no question about costs should be included in the schedule for the first trade census.

The following questions seem to be the most important of those practicable to ask: —

1. Kind of business carried on.
2. State whether specialty retail store, department store, general store, coöperative store, mail-order house, wholesaler, jobber, commission merchant.
3. Number of stores operated (i. e., branches).
4. What proportion of goods sold is manufactured by proprietor.
5. Actual capital, owned and borrowed, invested in the business.
6. Net cost of goods sold during year.
7. Total amount of sales during year.
8. Number of employees:
   - Male, 16 years of age and over.
   - Female, 16 years of age and over.
   - Children.
   - Total.

The results of the questions concerning the age and sex of employees would shed light upon the labor conditions in certain classes of stores. In addition some inquiry concerning wages

ought to be made, the more comprehensive the better. Unless preliminary investigation proved it to be inexpedient, it is suggested that information be collected from department stores and general stores as to the amount of their sales of each of several groups of commodities, such as footwear, dry goods, hardware, furniture, and groceries and provisions. It would be inadvisable to undertake to follow out this line of inquiry in all its possible ramifications but for the broader classes significant statistics could probably be obtained.

Practically all of the argument in favor of a census of agriculture or manufactures apply also to the proposal for a trade census, particularly since this trade census does not appear to involve more serious statistical problems nor a prohibitive cost. The number of persons engaged in trade is so great, their relation to our whole economic life is so intimate, the costs of marketing are so high, and such fundamental changes are taking place in market organization that we need reliable trade statistics which can be secured only through a federal census.

VIII. Report of Committee on Wiring, National Electric Light Association[1]

The work and report of the Committee is this year divided into three parts: —

(1) A study has been made to show the amount of work already done, what is being done and what remains to be done in the wiring of buildings.

(2) A report on the various methods of handling small customers and reducing the expense of wiring for such.

(3) A report on the question of the standardization of plugs and receptacles.

The Committee, in the fall of 1913, prepared a list of questions arranged to bring out the proportion of buildings already wired in territory supplied with electric service and the amount and kind of business that yet remained to be done.

[1] National Electric Light Association, *Papers, Reports and Discussions*, 37th Convention, Commercial Sessions, 1914, pp. 308–321. Reprinted by permission of the National Electric Light Association.

Instead of sending these questions out broadcast they were sent to a selected list of reporters only. Most of the answers were clear and good, but some were given in a form which would need explanation and the answers to some of the questions can be summarized so easily that instead of filling the proceedings with all the details, which would take too much space, and instead of presenting averages which might be misleading, a general form of presentation has been adopted. The need of concealing the individual figures of the reporting companies was also a factor in deciding on the form of the report. (See pages 242, 243.)

Business So Far Obtained

While the business of a company is measured by dollars or kilowatt-hours, and of a contractor by dollars or number of lamps, yet since all of these would be affected by a single big mill or factory, another figure, namely, number of customers, has been chosen for comparison. This is on the ground that when every store and residence is a customer the installation of services and the wiring of risers has reached 100 per cent, and then there is nothing more to be done to get people who are non-users to become customers, but on the other hand to obtain any further business after this point has been reached needs a different kind of effort.

Reporters were, therefore, asked to give the population supplied and the number of customers for two dates, a year apart, and these have been reduced to figures per 1000 population.

It is true that some companies report a customer using incandescent lamps, arc lamps or power on separate meters as three customers, while others report several families served through a master meter in an apartment house as one customer. When a company serves only a business district whose occupants live elsewhere, the ratio of customers to population is high, and other such causes of variation will occur to every one. While these may account for some of the extreme results, yet the general picture is probably accurate.

The figures run from 20 up to 200 customers per 1000 population, and we have heard of cases in this country where it has gone

TABULATION OF ANSWERS

Location and Key Number	Population	Customers per 1000 Population [1]	Residence Customers per 1000 Population [1]	New Buildings per 100,000 Population [2]	Per Cent of New Buildings Wired	Old Buildings Wired during a Year Per Cent to Single Dwellings already Served at Beginning of Year
	Over a	45	19			
No. 1 East	million	54	25	95	90	8
		20	19			
No. 2 "	"	26	12	108	51	5
No. 3 "	"	26	12	88		
		30	16		90	2
	Between	50	28			
No. 4 "	100,000 and	70	44	322	100	20
	300,000					
		50	50			
No. 5 "	"	62	62	268	95	6
		23	10			
No. 6 "	"	27	11	62	56	17
		27	12			
No. 7 "	"	35	18	83	90	3
	Between	37	25			
No. 8 "	50,000 and	42	29	202	85	21
	100,000					
		26	11			
No. 9 "	"	32	16	44	90	36
	Between	58	33			
No. 10 "	20,000 and	66	38			4
	50,000					
		72	55			
No. 11 "	"	78	60	26	100	4
		50	29			
No. 12 "	"	61	40	198	87	12
		37	14			
No. 13 "	"	46	20	145	72	18
	Between	49	36			
No. 14 "	10,000 and	54	39	263	70	3/10
	20,000					
	Between	154	121			
No. 15 West	300,000 and	158	129	373	100	..
	500,000					

TABULATION OF ANSWERS (*continued*)

Location and Key Number	Population	Customers per 1000 Population[1]	Residence Customers per 1000 Population[1]	New Buildings per 100,000 Population[2]	Per Cent of New Buildings Wired	Old Buildings Wired during a Year Per Cent to Single Dwellings already Served at Beginning of Year
	Between	43	25			
No. 16 West	30,000 and	62	40	2,000	83	3
	50,000					
No. 17	Between	42	No			
Middle	300,000 and	45	figures			
West	500,000		given			
No. 18	Between	110	78			
Middle	100,000 and	135	96	1,229	50	10
West	300,000					
No. 19	Between	71	34			
Middle	20,000 and	79	41	382	66	12
West	50,000					
No. 20		22	9			
Middle	"	28	11	1,192	60	
West						
No. 21	Between	72	40	300		
Middle	10,000 and	75	44		83	
West	20,000					
No. 22 West	Under	209	165			
	10,000	169	135	1,647	85	3
No. 23 "	"	72	49			
		78	52	11		2
No. 24 "	"	108	77			
		120	89	267	67	2
No. 25 "	"	82	72			
		87	84	555	96	10
No. 26 "	"	71				
		78	56	167	67	14
No. 27 "	"	126				
		138		381	75	
No. 28 "		111	80			
		109	82	24	50	4
No. 29	Between					
South	30,000 and	61	63			
West	50,000	88	77	118	84	23

[1] The first figure is for one year earlier than the second.
[2] Single dwellings. Apartments and stores not always included.

to 225 per 1000. The low figure of 20 is in an abnormal district, but apparently normal figures in the 30's and 40's occur in some of the Eastern cities, while high figures occur in the Middle West and West. Although 225 and even 200 may be abnormal, there are undoubtedly numerous places with figures over 100 up to 150 for actual development, without an abnormal reason.

It may be noted that two European cities, viz., Strasburg and Milan, although old cities with cheap gas and old buildings, already show a development well over 150 customers per 1000 population.

Possible Development

Every place reported shows growth still going on. Reporters were asked to estimate the limit of growth for their cities, but it was unfortunately suggested that they use a figure of 200 per 1000 population as the limit, unless they had reason to expect something else, and practically every reporter either used this figure or was influenced by it. However, reporters were also asked for an estimate of the present number of gas customers and water customers in their territory. Of course, many electric companies have all or some of their lines in streets not served by gas or water, while in many cases the water supply to an apartment or tenement-house serves several potential electric customers through a single water-meter. For this reason the electrical development in all except the large cities is well ahead of gas development, and the number of electric customers is in practically all cases more than the number of water customers recorded.

Since for this and other reasons the figures of the gas or water customers, considered by themselves or per 1000 population, seem to follow no particular rule, it has not been thought worth while to report them, but the number of water customers sometimes reaches 200 per 1000 and this points to at least a possible equal development of the electrical business. The number of gas customers in one or two cases exceeds the figure and reaches nearly 250, hence it is fair to conclude that the final development of the electric business may go up to 250 customers per 1000 population, and since several places have already reached 150 to 200 even

under present conditions, a figure of 200 customers per 1000 should not be deemed unreasonable for any company. Such a figure may seem high to companies that now have only 30, but they should remember that an annual growth of even 10 per cent will increase this 30 to 200 in about twenty years.

The fact that growth of population is different in different places would affect electrical growth somewhat, cities whose population grows fastest reaching their ultimate electrical growth sooner, but even with no growth of population the electrical development should ultimately reach at least 200 per 1000.

How Development Is Going On

All companies report a growth. This growth does not appear to differ very greatly in percentage of customers already served, whether in cities that have already reached a high development or in those that have their development before them.

If we take 200 customers per 1000 population as a probable limit, a company with 50 now has a growth of 150 more ahead of it, and a company with 100 now has only a growth of 100 more ahead of it. Nevertheless, the company with 100 today is just as apt to report a gain of say 10 per cent or 10 customers out of a possible 100 as the other company with 50 is to report a gain of 10 per cent of the old business or only 5 out of a possible 150. Of course a limit must come sometime when we shall get near to saturation, but it does not seem that it will be reached at any figure below 100.

This fact that the gain in companies that have reached different stages of development is more nearly proportional to the development already reached than to the number of prospects would be explained by the following: —

There is a certain increase in business that comes because existing customers spread the news. This is proportional to the number of customers already served. Another portion of the increase comes as a result of the effort made by the salesmen or wiring contractors, and this is proportional to the number of potential customers who are worked upon by the salesmen or wiring

contractors and the efficiency with which these men do their work.

That the growth actually recorded seems to be proportional to the number of old customers would point, at first sight, to ineffectiveness on the part of the salesmen, but this does not mean that salesmen do not do their work as well as possible, but only that as a matter of fact there is a large proportion of the growth that is independent of the solicitation done in that particular year. The salesman's work is, nevertheless, extremely important, since whenever he does get a customer he not only accomplishes that particular result but that customer spreads the news and results in other customers coming on in later years who would not have come if it had not been for the work of the salesmen in getting the first customer.

An important corollary from this is that while increasing the income from an existing customer by getting that particular customer to use more electricity is apt to show a greater increase in the income in proportion to the effort spent than the getting of a new customer, yet the result of the first effort stops there, while getting a new user on the lines to tell other non-users of the advantages of electricity has a cumulative effect that goes on until we have 100 per cent of development.

The next question of interest is whether future development is to be chiefly from residence or business places, and reporters were asked to give the number of residence customers (including apartments). This number has been reduced to figures per 1000 population. As will be noted, the number of residence customers runs from about 40 to 100 per cent of the whole number of customers, the cases where the number of residence customers and the whole number of customers are equal being, of course, in purely residential towns. Leaving out such anomalies, the percentage of residence customers to the whole number of customers runs from 40 to 60 per cent, where the total number of customers is low, and up to say 80 per cent, where the development is high.

Putting the figures another way, we find that the number of residence customers runs from 10 to 130 per 1000, and the balance (business places) runs from 10 to 30 per 1000 population.

The figures have been given for two successive dates and, as will be noted, the proportion of residence customers is increasing everywhere except in one city. That is a city where, for special reasons, the total development is as yet very small. This only brings out the well-known fact that the early development in nearly all our cities is in business places and that most of the growth now going on and most of the future growth is to be in residences. Another method of stating this is, that if a company is growing 10 per cent a year it will find that its business customers are growing at the rate of only 2 or 3 per cent, while its residence customers are growing at the rate of 15 to 25 per cent; or, to say that of the net customers added during a year from 2 out of every 3 up to 9 out of every 10 will be found to be residences.

Development from New Buildings as Compared with that from Old Buildings

The reporters were asked for estimates on the number of new buildings erected during the year and for the percentage of these that were wired. The figures of new buildings are given in numbers per 100,000 of population. The estimates from the reporters in the different cities show that somewhere in the neighborhood of 80 to 100 per cent of the new buildings are being wired each year, although a few cities report lower figures.

The percentage of new buildings wired for any city indicates a lower limit for the possible growth, since if under present conditions 50, 85 or 100 per cent of the new buildings are wired this indicates that when every building in the city has been built or rebuilt within say 20 years, the company should have 50, 85 or 100 per cent of the possible number of customers. Hence, if we take 200 customers per 1000 as a probable limit, a city that is getting 50 per cent of the new buildings wired should look forward to an ultimate development of 100 customers per 1000 population, even if its present growth is very much less than this, and a city which is getting 100 per cent of the new buildings wired should look forward to 100 per cent development, or say 200 customers per 1000 population.

Old Buildings

The next figures the reporters were asked to give were estimates as to the number of old buildings wired.

Since the increase in customers, whether from new or old buildings, does not seem to be related either to the number of non-customers or to the population, but to the actual number of existing customers, therefore, in reporting the figures the number of old buildings wired has been given as the percentage of the single dwellings already served.

The reporters were also asked to give the number of old apartments wired, and the answers show a pitifully small number, so small that it is not worth reporting. This is, however, natural, because apartments are practically all renting propositions and rented on moderately short leases or without lease. The difficulty of getting rented buildings wired is well-known. The tenant does not want to make an investment for the benefit of the landlord and when rents are stationary the landlord is satisfied and does not want to take any action. When rents are increasing the landlord is more than satisfied. When rents are decreasing the landlord hesitates to put more money into a losing proposition.

Since, however, it is an undoubted fact that an occupant will pay well for the comfort of having electricity, there might be a field for some wiring company (which would be really a financing or investing company) that would wire apartments whenever the landlord would agree to allow the wiring company to make a charge to the tenant for the wiring.

We say there might be a field for such a company, but the difficulty is that after a wiring company had started to develop such a business the landlords would take the cream and leave only the skimmed milk. On the other hand, a central station should be well able to invest some thousands of dollars in the wiring of houses that are to be rented and to allow the use of such wiring only at a good rental, pending its sale to the landlord at a profit. There might be cases where such wiring could neither be rented nor sold, but these would be few and the loss would be less than the expense of getting the rest of the business in any other way.

Returning to the question of whether the increase of business is coming from new buildings or old, the numbers of buildings or apartments wired, new and old, should be a measure of the business gained during the year, just as the increase in actual number of customers served is a measure of the new business. In other words, the new customers obtained should be about the same as the total number of places wired up.

The figures for any given year are, of course, not directly comparative because buildings newly wired might not come on to the system for a time, and on the other hand, there might be an increase in the number of customers in buildings that were wired in past years, or from changes from master meters to separate meters, and *vice versa*. One company, for instance, showed an increase of 3000 single-dwelling customers during the year, against only 2000 such buildings, new and old, wired up during the year. On account of such variations it has not been thought worth while to give the actual figures in the report or in any table, but the increase in customers has been compared with the number of new and old dwellings and apartments wired up, and checks up, on the whole, fairly well. This also shows that except in a few cases the growth in the number of customers for the year is accounted for almost entirely by the new buildings and does not come from old buildings.

Companies are getting most of the new buildings and, further, this accounts for most of their growth. Companies are getting only a very small proportion of the old buildings that might be wired and this accounts for only a small proportion of their growth. For a company that is growing 10 per cent it will be found that in many cases four-fifths of this growth is accounted for by new buildings and only one-fifth by old buildings. However, this must not be taken as minimizing the importance of soliciting orders from old buildings.

The probable reason why we get such a large proportion of the new buildings is that they are coming to us anyway without much effort. If it were possible to say how many new buildings we would get without solicitation we should probably find that our salesmen in any doubtful case are really just as effective on

old buildings as on new. There are cities reporting a really considerable number of old buildings wired, some companies stating that during a year they have secured the wiring of as many old buildings as new. These were cases of special campaigns or sometimes of changes in management. Even then, the proportion of old buildings wired to the number of old buildings that might have been obtained is very small; i. e., to get 50 per cent of the possible number of new buildings shows up badly, while to get 10 per cent of the possible number of old buildings would be wonderful.

Of course, if a company should once get 100 per cent of the old buildings wired it would have no work left to do except to get new buildings and to increase the use of current among existing customers, but there are very few companies that do not show a much bigger field for the work of their salesmen among old than among new buildings. The number of old buildings wired in any year is small, and yet this is not because we cannot get the old buildings. Every year some old buildings are wired. With a hard campaign more are wired. The cases where a large number of old buildings have been wired are almost all cases of special campaigns or changes in management, which have been the equivalent of a special campaign.

If every year we are getting some old buildings wired, it is only a question of time when they will all be wired. It is not a question of can we get them, but of when shall we get them, and the harder we try the quicker they will come.

Minimum Size of Customers

The reporters were asked for estimates as to the minimum size of customers that were deemed profitable, and the answers ran about one-quarter kilowatt connected and about $9 to $18 a year income.

The question of profit depends, of course, on the average size of customers and how close they are together, as well as on the minimum size. So long as the average size is satisfactory, it is probable that even very small customers bring in more profit than expense. Likewise if customers are only close enough together,

it is probable that very small customers can be profitably served. At least the experience of the gas companies, of the five and ten cent stores, of the Standard Oil Company, and of some European and American electric companies shows that if the methods of handling small customers are properly designed and if there are enough of them close together, the size of the individual customer may be very small and yet the total profits very large.

On the other hand there is no question that when a customer requires a $100 service and a meter all to himself and yet has only one-quarter kilowatt connected or gives only $9 a year income, that customer is worse than none. In such cases, of course, the customer should pay a portion of the service cost, or a high minimum.

IX. Guiding Salesmen by Map and Tack [1]

By W. A. Waterbury

Map and tack systems are one of the most important equipment features of offices which handle traveling salesmen, selling agents, or a more or less extensive mail order business. They are geographical charts that, in a way, keep the management of your business under close supervision. They are to the manufacturer or merchant as the train charts are to the train dispatcher — indicators showing what is going on at every critical point.

You can make the map and tack system show in condensed form the territory covered by your dealers, agents and traveling salesmen. You can use it to lay out a salesman's route and to follow him as he pursues it. It keeps you in constant touch with his work and lets you know at all times what he is doing and whether he is making or losing money.

The map also tells you at a glance where prospective trade lies. It locates fields that have not been developed. It shows you where collections are due, and where advertising is producing the best results. It may be drawn upon for a hundred and one other points important to your business.

[1] *Library of Business Practice*, vol. 5, pp. 137–146. Reprinted by permission of A. W. Shaw Company. Several forms have been omitted.

As generally used, the map and tack system consists of one or more cabinets of shallow drawers, which contain the maps required. Sometimes a single drawer is used for a map of a single state; sometimes a drawer will contain only a portion of a single state and at other times two entire states, according to the character of your business and the money you can afford to put into the equipment.

Tacks with different colored heads and balls of different colored twine are used in connection with the maps to indicate different business conditions.

This is the simplest form of a map and tack system. Probably no two concerns apply it in exactly the same manner. The equipment is merely the foundation and may be regarded as the tool with which to work.

I have found my way of operating the system to be simple and practical. Anyone can put it into practice at any time without conflicting with other interests.

I will take as an example my company, which employs fifty to a hundred salesmen to handle and sell a marketable article that is in more or less demand in all parts of the country. In addition to the salesmen on the road, I have a resident sales organization of dealers and agents who are under contract to handle my line of goods and who have, under the contract, exclusive rights to the sales in their territories. These agents are scattered. Some control a single town or city, others an entire county, and some a state.

As I have no right to operate in districts allotted to exclusive agents, I have to keep my traveling salesmen out of their territory. In order to do this, it is important that exclusive territories be designated on the maps. I give an exclusive contract to a resident agent or dealer who can secure more business, or the same amount of business, at less cost than I can through my traveling men. It is vital that I keep myself informed of his productiveness and prevent it from diminishing. To do this I use white tacks.

A white tack indicates an exclusive agent. If he controls a town or city, a single white tack inserted at that point on the map

is sufficient. If he covers a county or large territory, a line of white tacks along the county or territorial boundaries, a black string connecting them, and a white tack to mark the agent's headquarters in a town or city, show the district covered and the permanent address of the man in charge. If a territory has more than one agent, two white tacks indicate the fact.

It is, of course, essential that there should be a way of naming agents by inspecting the map. An index card for each agent supplies this information. A drawer in a card cabinet, subdivided according to states, cities and names, will hold the cards. The cards appear under the names of the cities tacked in white and contain the names and addresses of the agents and a description of the territories. Duplicate cards containing only the names and addresses are kept separately with the cards of all the other agents, arranged alphabetically by names.

One glance at the map shows the territory controlled by an exclusive agent. Reference to the first card filed under the name of the city he uses as headquarters shows who he is and the territory he controls. The second card gives only his name and address. It is the cross index and locates the territory and address of an agent who is mentioned only by name in correspondence. Reference to the map makes the information about him complete.

On receipt of an inquiry I consult the map and the town or city that furnished the prospect. The original inquiry is given a number, and all future dealings or correspondence with the inquirer is conducted under that number. An index card which carries the name and address of the prospect is given a corresponding number. We do not file correspondence about prospective business in the general office file until the inquirer has been sold, but file it separately and by consecutive numbers. The number of the card acts as a guide for locating the correspondence. These cards are filed alphabetically by states, cities, and names.

As soon as a prospect has been secured, the city tacked in black, a number given and an index card filled out, I send circular matter, prices and other necessary information. Two carbon copies of the letter are made. The stenographer attaches one to the original communication for temporary filing, and forwards the

other, with an appropriate letter, to the agent controlling the territory from which the prospect answered. I never send the original communication to an agent, but write a reply worded so that he can understand the purport of the original inquiry. If this is ambiguous, I attach a copy of the inquiry.

The black tack remains in the map until the resident agent notifies the home office of a sale. After a sale it is removed and a blue tack substituted. If the cards show other prospective business in the same city, both blue and black tacks appear. The proper index card is marked " sold " and transferred to the back of all cards in that state into a " sold " compartment. The compartment is arranged alphabetically under customers' names. The correspondence, which can be located by the number on the card, is removed from the numerical file and transferred to the general file.

Thus a black and blue tack indicates business accomplished and work still to be done, and reference to the cards, the correspondence and the "sold" cards, shows instantly the prospective trade and the sales. A summary of the business done in any town can be conveniently kept on a card in the " sold " file. In this manner the amount of business done by any agent for any period of time can be quickly ascertained.

Sometimes it is difficult to induce the agent to notify you when he makes a sale to a prospect you have referred to him. Usually a reminder will secure action. A monthly statement of the sales enables you to tack up the maps, add to your cards and assemble a complete statement of the business done in an agent's territory.

X. Determining the Value of Salesmen[1]

By Donald L. Kinney

A star salesman for a wholesale crockery house came into the sales manager's office. " Mr. Stewart," he said, " I must have more money next year. My sales have been $20,000 more this year than last, and my expenses have increased only one-half of one per cent." He got the raise.

[1] *System*, April, 1910, pp. 402–406. Reprinted by permission of *System*. Forms omitted.

Then came another. "Mr. Stewart," this salesman ventured, "I think I ought to have more money next year. Of course, I know that I haven't sold much more this season than last, but I have been with you fifteen years. I went out to that territory when you didn't have an account in the state. I have built up such a good will for the house, that I believe the mail order sales from my territory will exceed those from the territory of anyone else on the force."

But Stewart did not *know* this, or if he did, he probably believed that the house was as largely responsible for the good will as the salesman. Stewart had a rather firmly rooted idea that a salesman's value to the house is determined by a single problem in division — total selling expenses divided into total sales gives percentage of selling cost. By this process Stewart found that this salesman's percentage was a trifle higher, and his total sales considerably lower than those of the star. Result — this salesman did not get his raise.

Now Burke, a competitor of Stewart located two blocks away, had the same requests under similar conditions from two of his salesmen. But in this case, the star was refused the raise, while the apparently poorer salesman secured a substantial increase. And in spite of this seeming reward of mediocrity at the expense of ability, Burke is the keener sales manager. The card index in his desk showed that although the star salesman had sold more goods than any other man in the house, and his expenses were as low as the rest, his *net* profit to the house was considerably below the standard. He had concentrated his efforts on the staples which ran into big figures but yielded small profits. The other salesman had devoted his time to the more profitable specialties, which held down his gross sales, but increased his net value to the house. Burke's cards showed this fact and this salesman got the raise.

These two business houses are typical of two classes. One weighs its salesman with gross sales and a hazy appreciation of the good will for which the salesman is responsible. The other type of business house appraises its salesman with the standard of net profit and a definite analysis of the salesman's good-will

patronage. Houses of this character have a measuring stick which enables them to point to each salesman's position on the scale of efficiency.

Two factors determine the salesman's value: his net profit to the house, as shown by actual figures; and his trade building ability as reflected by mail orders, a continued patronage and good will as shown by the trade's attitude toward the house in their letters and conventions. The first of these is an accounting proposition and can be made as accurate as figures will allow. The second deciding factor combines record keeping and a cultivated ability on the part of the employer to determine how much his salesmen are worth to him as business builders. Both of these factors must be applied to outside and inside salesmen — the men who distribute goods for the manufacturer, the jobber, and the retailer.

In order to secure figures which show the net profit of salesmen, any industry must be divided first into several departments. The number will depend on the volume of business. A large manufacturer or wholesaler might need a score of departments while the needs of a small retailer, with a half dozen clerks, would be satisfied with two or three divisions.

The departmentalizing of your business is absolutely necessary as a first step. Grouped sales show from which department your men are making money for you. They also enable you to determine which departments are more profitable than others.

A manufacturing chemist with six departments finds that three forms are all that is necessary to secure the sales data. On the salesman's order sheet are entered all the items as finally billed out to the customer. In addition to the data provided for in the columns the cost of each item is written in the proper place together with a certain percentage allowed for overhead cost. When this sheet has been received at the house and attended to by the order department, where it is totaled and numbered, the results shown are posted to the salesman's analysis sheet. The order invoice number and name of customer is entered at the left, and then under the six succeeding departments are listed the selling prices of the various items which appear in the

order. In the adjoining six columns is listed the net profit on each item. This includes accurate overhead charges secured from the cost records; and sales expense, secured from the salesman's expense account. Under the heads " total sales " and " total profits " are entered the amount of the invoice and profit to the house on this sale.

At the end of each month these figures are classified and transferred to the summary sheet. On this sheet in the spaces opposite each salesman's name are entered the number of days the salesman was out, average daily sales, total expense, average daily expense, cost to sell and total sales in all departments. In the next columns are listed the total profit this salesman has made for the house in each department and total profit in all departments.

With these figures before him, the sales manager knows precisely how much money each salesman is making for the house.

But this sales manager is broad enough to know that figures may lie. He knows that second to the goods' quality, the salesman is the first factor in building trade. Accordingly, this sales manager has all indirect orders classified by salesmen's territories. These orders, together with the net figures secured by the method just described, and a proper appreciation of the good will which the salesmen have built up for the house, give the sales manager an accurate basis for determining the exact worth of his salesmen.

In a wholesale business where the distribution of goods to retailers demands a large number of salesmen, the need for a method of determining the value of salesmen is even greater than in a manufacturing business whose salesmen are specialty men, calling only on the jobbing trade. One of the large wholesale grocery houses, employing nearly one hundred and fifty salesmen, has developed a remarkable system. It is simple and efficient.

When an order has been filled and O. K.'d by the order department, it is sent to the accounting department. The various items on the order are not grouped by departments, so the order is first handed to a boy who indicates in colored ink the numbers of the departments to which credit should be given for the various items in the order.

When this is done, the order is turned over to another person in the accounting department who enters in the first two columns of the order sheet the cost and profit of each item. The items are then grouped on the salesman's individual analysis sheet, the colored department numbers on each item guiding the clerk as to which division each item should be entered under. This clerk enters on the first two divisions of the analysis sheet the salesman's gross sales in each department. In the next two divisions he enters the net profit on each item.

From this analysis sheet a clerk draws off the total sales and profits each day and enters them on a temporary sheet. When these have been proved correct, and have been posted to a ledger, he transfers the totals to a large summary sheet. This sheet is vertically ruled to show the names of salesmen, the number of each department and the articles sold in each. The horizontal rulings give spaces for entering the total gross sales and profits. The salesmen's names are entered alphabetically in the first column. In the spacing directly opposite are entered the departments and the gross sales and profits in each.

The salesman's record is completed when his gross sales and percentage of net profit for the month have been entered as indicated in the sales manager's card index.

The figures shown on these records form the first basis for weighing every salesman in the organization of this wholesale house. The figures, however, are supplemented by others showing the same statistics for all mail orders, for which the salesman receives full credit.

But these figures do more than merely determine the value of salesmen or departments. The salesmen's cards are kept up to date each month and are constantly before the sales manager. When he notices in May that Salesman Jones is falling down on gross sales, he immediately gets after him and boosts him back toward his record.

The next card may show that while Salesman Smith's gross sales have increased over those of the two previous months, his net profit has fallen below the standard. When that salesman comes in at the end of the month or before, the sales manager

takes him to the monthly summary sheet and shows him why he is not making the money for the house that he should.

This sales manager uses these records constantly. Although the accounting costs his house $10,000, the facts obtained pay for themselves ten times over.

In the retail store, the counter salesman must be put through the same acid tests. He must first make a satisfactory net profit for the house. He must also be a trade builder — a clerk who, through his own efforts, will draw trade to the store year after year. And the retailer, like the manufacturer and wholesaler, may find that a salesman's value is not always determined by figures.

Several months ago, the manager of a retail shoe store, employing nearly fifty salesmen, hired a new clerk. Before the end of the month, he saw from the sales slips and weekly summary sheets that the new man was distancing salesmen who had been in his employ a dozen years.

Apparently, here was a magician who deserved an immediate reward of at least a fifty per cent increase in salary. But this manager was a veteran, and knew that these astounding figures could be neutralized. He started an immediate investigation, and the next morning the star salesman was closeted with the manager, who told him in emphatic terms that he must either change his selling tactics at once or leave the organization.

This salesman had the faculty of "sizing up a customer." Usually, he could determine a slow buyer as soon as he crossed the threshold. These he avoided, to concentrate his efforts on quick sales. When he did get a customer who took a half hour in search for foot comfort, he would turn him over to the usher.

"This man can be sold," he would say, "but I can't seem to suit him. I think one of the other boys could make the sale." And while another man was taking one-sixteenth of his day's working time to please a difficult customer and build trade for future years, the star salesman was making three or four "quick sales."

The sales manager of this shoe firm receives weekly slips showing the number of "returns" made on a salesman and the num-

ber made to him. One month the manager observed a certain salesman had an extraordinary number of returns made on him. Examining the slips of this salesman and those of the salesman who fitted the customers again, the manager found that in every instance the customers secured larger sizes at the second call. The manager then knew that this salesman was fitting too snugly and took steps to correct the tendency. By such means the manager judges the salesman's ability to sell satisfaction, and to him such ability greatly discounts big totals, for dissatisfaction is a poor advertisement.

In a large department store employing hundreds of clerks, the classification of sales involves more details, but is secured in practically the same way as described for the manufacturing and wholesale industries. Each evening the various cashiers send their cash and credit slips to the auditing department where clerks classify the slips by departments. The total cash and credit sales are then entered on a distribution sheet which must check with the cash posting sheet.

While the clerks are classifying the sales slips by stores and cashiers, they also classify them by salesmen. The total sales of each clerk are secured once a month with adding machines and entered on long slips of paper which show the store number, date, number and name of clerk, salary, days worked, total sales, daily average and percentage. These are sent to another division of the auditing department where they are used as the basis for making up a monthly summary sheet. This sheet is ruled to show the store, the number and stock carried, clerk's name and number, wages, days worked, sales, daily average and percentage.

These figures are shown for the twelve months, and at the end of the year, the yearly totals are added and entered. The clerks' names are entered on these sheets alphabetically, and their monthly record of sales stands as the accurate standard for determining their value to the house.

Net profit and good will — these are the two factors which must be balanced in weighing every salesman, whether he works behind a counter or over a sample case.

XI. Records Salesmen Like [1]

By K. K. Bell

I like to say that I have seventy bookkeepers to handle the records of one hundred salesmen. That is not literally true, of course, because not all of the seventy are bookkeepers, but it is strictly correct to say that I have seventy people who keep records for one hundred salesmen.

And even at that, we are not over-supplied with records. Selling costs with us have not gone up — that is, net selling costs. If anything, they are slightly lower than they were five years ago. Volume accounts for the decrease, and it is for the purpose of getting the volume that we have so many office people watching the work of our salesmen.

While the net selling cost has decreased with us, this does not mean that it is growing easier to sell. On the contrary, I am confident it is becoming every year more and more necessary to dig deep beneath the surface of sales territories. We once purposely sent our salesmen out for a hasty run over large territories. They were able merely to scratch the surface. This method of selling, indeed, brought results and quick profits, but in the long run it did not bring increased returns.

Intensive methods of selling, however, do that very thing. And we have found in our business that the deeper you go into a sales territory, the more possibilities you find for the development of sales. I think an outline of our methods of watching sales will prove interesting to nearly everybody, simply because it is getting harder to sell, and a solution must be found.

Our records begin with the salesman himself. His daily report sheet is made out with a great deal of care. We require a good many details. On the other hand, we provide a report sheet which enables him to report these details without much difficulty.

Every dealer in the country who can handle our goods is on our list. Our territories are so arranged that the salesmen will call on every one of these dealers on an average of three times a year.

[1] *System*, February, 1916, pp. 198–201. Reprinted by permission of *System*. Mr. Bell is sales manager of the Calumet Baking Powder Company. Forms omitted.

Quotas are set for every territory. We go even farther than that, however, and get separate quotas for every district, state, county, town, and dealer.

Our quotas are based on population. We figure how many cans of baking powder should be used in a year by each group of one hundred people; and on this basis we figure out what the total consumption of baking powder in the country is. Then we figure the percentage of this total consumption which we think our company should get. Worked out in detail, this gives us the amount we should be able to sell to every dealer in every part of the country.

Salesmen are routed very carefully from the home office and we instruct them not to deviate from the prearranged plan, except in unusual cases. As I said before, they are required to call on every dealer. In cases where they are not able to see the dealer himself, they are required to report the exact circumstances which prevented them from seeing him. This plan gives us a very complete hold on all possible sales of baking powder in the whole country.

The salesmen themselves are backed up by two experienced correspondents in the home office. These correspondents have at hand all the data regarding dealers on whom the salesmen themselves could not call, or to whom they were unable to sell goods. They spend their entire time writing personal sales letters. The results of this second process of covering territories with a fine-tooth comb are splendid. Each of these correspondents makes more sales in the course of a year than any one of the salesmen in the field.

In the group of columns under the word "sales," on the daily report form which is used by the salesmen, the actual transactions of the day are recorded. Four columns follow this and the salesman enters in the proper places what brands of products are first, second, and third best sellers in each merchant's store. The final column enables the salesman to report any cases where he could not make a sale. He can give his information very briefly. The correspondent knows what kind of a letter to write in order to line up the merchant for possible sales.

On the back of this report sheet the salesman adds information of interest to the advertising department. He notes very briefly exactly what kind of assistance he gave to the advertising department in connection with the advertising of individual merchants.

Our salesmen, of course, are instructed to help the dealers wherever they can by distributing such devices as will help the sale of our product, and also by suggesting window trims, methods of display, and the like. It is essential that the advertising department should keep in touch with this work. The salesman's report makes it possible for them to do so.

Expense accounts are also turned in by the salesmen daily. Here, as in the daily report of sales, we try to make it easy for the salesmen to record the facts which we must know, and at the same time simple for us to summarize the expense in the office.

Each week every salesman receives a new expense book. It is convenient in size and he can easily slip it into a coat pocket. Columns provide space in which he can enter, without unnecessary writing, what he spent money for in the company's interest. On the stub he can record the total amount of his day's expenses.

The slip itself is torn off, attached to the daily sales report and mailed to the home office every night. At the end of the expense book is a space in which the salesman can enter a summary of his sales for the week, itemized by dealers. On the outside of the back cover is his route schedule for the week, showing the towns he is to visit.

At the end of each week the salesman sends his book to the home office and the totals carried on the stubs in the book must agree with the total of his daily reports of expenses.

We have found that this careful, daily handling of expenses makes the salesman himself more systematic and that it also saves the house an amount of money which is well worth conserving.

We make a summary of sales for each salesman every month and write the summary on a card. Each card contains the report of all the salesmen in one state. In addition to giving the salesman's record for the month of the current year, it also gives his record for the same month in the previous year.

We make a somewhat more elaborate summary at the end of each year. This form shows the salesman's quota for the year, his reported sales for the current year and the previous year, the details of each trip, shipments for the year, and the open contracts outstanding at the end of the year.

This information is given for each town in the salesman's territory. We can therefore very quickly check up where he has been doing better and where he has not been doing so well as in the previous year.

The salesmen are judged in three ways, as follows:

(1) By their quota.

(2) By the effectiveness of their distribution.

(3) By the number of five and ten-pound cans sold.

A "hundred-point man" is one who makes his quota, secures what we consider a one-hundred-per-cent distribution, and sells as many five and ten-pound cans as an even balance of our business requires. Salaries, of course, are adjusted on the basis of these three considerations.

Our plan is simply based on the truth which I believe is being widely recognized — that the more closely you work a territory, the better results you will get out of it. Farmers in the old country as a rule get much larger crops from an acre of ground than we average in this country. The reason is that ground is limited over there, while in this country we have been — in the past — free to pick and choose.

It used to be that we could pick and choose in the same way in selling goods. That day is rapidly passing, and the necessity is more and more insistent that we dig deep — and not merely scratch the surface.

XII. Graphs for the Sales Manager[1]

By Stanley G. Tarrant

When the general manager of a roofing company found it necessary to be absent on business in San Francisco for nearly three months last year, he selected from the reports which came

[1] *System*, December, 1915, pp. 648–649. Reprinted by permission of *System*. Charts omitted.

to his desk those that he wanted forwarded to him to help him keep in touch with the business. His statistical department listed these reports and found that they numbered exactly one hundred and ten, even after eliminating several as valueless.

The company's statistician doubted if the executive could find time to go over all these reports. So he set about figuring out how they could be condensed. When his experiments were finished he had the one hundred and ten reports combined into twelve graphs or charts. These graphs gave a complete survey of the information in the records—and gave it in one-tenth of the time.

This experience illustrates the practical usefulness to which graphs can be put in almost any type of business. In almost every case where comparisons are desired, they bring out the important points more vividly than mere figures can. They keep facts from losing themselves. Also, by showing tendencies at a glance, they save the time of wise executives who desire to make use of past performances when planning for the future.

The success which the sales manager of a small company in the West has had with a graphic chart corresponds with the advantages obtained by the statistician who was anxious to aid the general manager of the roofing company. He uses his graphs to keep track of the results obtained by his salesmen. The cost of keeping the graphic records is moderate. The information they supply is valuable for comparative purposes. This method is suggestive and probably could be used profitably by many other managers desiring a comparative record of the effectiveness of their men.

As part of his office equipment this sales manager uses a flat-topped desk six feet long, the top being entirely covered by a piece of plate glass. The comparative chart is kept under this glass.

The chart is drawn on millimeter paper. A six-foot length of this paper takes care of the records of twenty-seven salesmen. The chart is arranged for a monthly record. If so desired, the comparisons could be made weekly, or for any other period — the only consideration is that the longer the period, the longer must be the paper, in order to display the same number of comparisons.

In the column headed "number," a scale is printed which starts at zero and works upwards, by even steps, to somewhat more than the maximum number of calls possible per day.

In the column headed "dollars," a scale starts at zero and works upwards to a point about 50 per cent higher than the average sales per man per month.

In the column at the foot of the page marked "average cost," a scale starts at zero and works up to a point higher than the maximum cost per call.

The figures in these scale columns depend, of course, upon the nature and quantity of business obtained, and are not shown here because they would not apply in other businesses in precisely the same way, although it is easy enough to fit them to any business.

The framework of the chart is drawn once each year. It shows graphically seven facts about every salesman. In the upper portion, the following facts appear:

1. Number of orders obtained: black line;
2. Value of orders obtained: black dotted line;
3. Number of calls made: green line;
4. Average value per order: green dotted line.

On the lower portion of the chart, these facts are shown:

1. Average cost per order (salary, commission and expenses): black line;
2. Average cost per call: black dotted line;
3. Average cost per $100 of orders: green line.

These seven points are plotted and drawn on the one chart to show the records of twenty-seven salesmen in less than four hours a month.

To secure the information which goes on the chart, each salesman is provided with a supply of post cards. He fills out one of these every day and mails it to the office. On it, in the convenient spaces it provides, he shows the number of calls he made during the day, the number of orders he obtained and the value of these orders.

When the cards are received at the office, the information each carries is transferred to the salesman's individual summary and at the end of each month the figures on this form are totaled and the averages figured.

The whole routine in connection with keeping this chart does not represent more than two days' work per month for a clerk. So it is obvious that a similar plan can be installed and operated at a correspondingly low cost by any manager.

XIII. Advertising and Sales Department Records[1]

By Edward S. Babcox

In these days of strenuous competition, the sales manager is becoming more and more a general; he is armed with facts and figures about his territories, knows the possibilities, and requires his sales agents and salesmen to produce quota, or show why.

The determination of a fair quota for each territory is the basis of record keeping in a certain large concern selling a well-known device for office use. Note how scientifically they do it.

First they determine from census and other Government reports that there are so many concerns in each of seventy-five lines of business in the United States. Then they ascertain how many there are in each line in each territory.

Secondly, from their records they determine how many machines they have sold to date to each line of business. They figure this way; if there are 5,000 banks in the country and they have sold 2,000 of them, that is 40 per cent. Therefore it is fair to expect that every sales agent shall sell 40 per cent of the banks in his territory this year.

Every sale is reported to the home office, and is tabulated so that the facts about lines of business are available. Then, if a representative comes to the home office and objects to his quota, the fundamental facts and figures are shown him, and frequently he sees that he has been missing many good bets in his territory by overlooking certain lines of business.

His quota analyzed by lines of business wakes him up to the possibilities of his territory, and he determines that he can do what the other men are doing, and usually does.

Go into the office of the general sales manager of that company and you will find one desk, one table, one hat tree, and six or eight

[1] *Printers' Ink*, August 29, 1912, pp. 12–17; September 5, 1912, pp. 51–58. Reprinted by permission of *Printers' Ink*. Illustrations of forms are omitted.

chairs. Desk and table are always clear of papers; no trays of held-over work being visible.

His assistants and clerks do the detail work.

A certain concern manufacturing a product which is more or less complex and which must be sold in the customer's office by the manufacturer's salesman, rather than in the display room, requires its branch salesmen to keep accurate records of prospects and customers. Each branch city is divided into territories and a man assigned to each. The home office furnishes for each territory a list of all possible buyers, arranged alphabetically, each on a 5 x 3 card.

Each representative calls on his list systematically and reports in person daily to his manager (who has previously received his written reports). Thus he gets pointers about his territory from a more seasoned man. He has a card for each customer, and one of different color for each prospect. Usually he indexes these by street and building, so when he calls in a certain section he can take all his active cards for that vicinity and make every call count.

Each of these cards has a little projecting tab. The tabs range across the top in seventeen different positions and are numbered, one number to a tab. Each number represents a different business: (1) architects; (2) wholesalers; (3) retailers, etc. These business classifications enable the salesman effectually to circularize his list with appropriate advertising matter and conserve his ammunition, none being wasted.

If the advertising department gets out a folder for architects, there is no need of circularizing manufacturers, retailers, railroads, and others with it for those cards carrying architects' tabs can be easily picked out.

This particular system for branch salesmen is actually increasing sales in the business where used.

Travelers' Record System

The traveling representatives of this same firm have definite territories, ranging from one state to four or five in sparsely settled sections. They visit each town on an average of four times a year. Between times certain prospects will need atten-

tion, so the sales manager has each man carry a supply of cards. Regular customers are entered, one on a card, and at each city the traveler receives cards for that town. The matter at the top of the card is usually filled in at the home office, and the salesman secures the balance of the information and fills it in after calling. Of course he makes out a new card for each new prospect, and if he so directs, the correspondence department follows up any prospects he reports. Frequently sales are closed between his calls. If this is done, the sale is entered on the reverse side of the card, and is returned to the traveler next trip. Each card is good for four calls, and usually lasts a year. Notice that the reverse side of the card has space for information valuable to the traveler. Receiving the same card on four successive trips, and after that a new one with the old one attached, he has his own record to go by and thus refreshes his memory about a certain concern before calling.

This system is the result of years of experience, and the one card gives the salesman exactly the selling information he needs.

The Sales Manager — an Executive

The sales manager wants facts and figures — not guesses and surmises. His records are really the finished photographs which show the progress of the concern. Into his records are incorporated the reports from branches, agents, travelers. With the reports he gets from the financial man — profits, costs — these enable him to chart daily the course of his business ship. They are truly his compass. Sales managers in different lines of business require different kinds of records; the following are suggestive and may be helpful.

A card kept by one sales manager shows the amount of business done by a branch or agent over a period of ten years, and is of untold value to the executive who designed and uses it. Comparisons may be made instantly with all the figures before him in this way. This little card is really a compact encyclopaedia of sales facts.

The same sales manager uses a form to show results of correspondence department work. One card is made out for each

correspondent, and the detail information is filled in from month to month so that the sales manager can trace increases and decreases accurately and effectively.

Such a card is valuable, too, when salary-raising time comes around. It shows whether a man is earning his monthly stipend, or not.

An untold number of records might be illustrated and described here. This is neither wise nor necessary. Other valuable records which many sales managers require, however, are:

1. Employees record. A suitable 5 x 3 or 6 x 4 card for each employee in the sales end of the business, showing date of original employment, transfers and general history.

2. One card for each item in the line, showing sales by months for that item.

3. Card for each item manufactured, with prices of corresponding item sold by competitors.

4. Card for each branch office, showing sales, expenses, gross and net profits, etc.

These and many other similar records, which every down-to-date sales manager has in some form in his office, constitute a sort of business barometer which he watches as a physician watches the fever chart of his patient.

Advertising and sales departments are so closely related nowadays that it is difficult to discuss them separately. Where there is need of both departments in a business, the more closely they are associated, the better. The ideal condition obtains when the same man is sales and advertising manager with able assistants to look after different portions of work under his direct supervision.

Facts and figures are at a premium in most advertising departments; because advertising is more or less intangible; because it is not a definite science where the dollar expended can be counted upon to produce a definite return; because many advertising managers think that no adequate records can be kept, and therefore do not keep any.

As a matter of fact, they beg the question, — the need for accurate records really varies inversely as the amount of facts

at hand. The fewer the facts the greater the need of a record of them.

The easiest way to get a bird's-eye view of advertising department systems is to outline a definite series of methods now in use in a typical department with which the writer is familiar.

To begin with, the advertising appropriation is three and one-half per cent of gross sales.

This particular advertising manager at the beginning of each year divides his funds under six heads, as follows: —

1. Printed Matter.
2. Publicity.
3. Engraving.
4. Postage.
5. Salaries.
6. Miscellaneous.

He makes out a sheet with these headings down the side, and months across the top. His assistant keeps a monthly record of expenditures under each heading, so that the advertising manager knows always where he stands. The totals are easily obtainable because each order is numbered, and when the bill comes in its amount is listed on a day-book journal-sheet which has column headings for each of the six subdivisions. Totals each month give the expenditures. So much for the financial side.

Record of Circularizing

Whenever it is decided to send out circular matter, a 5x3 card is made out. Many facts are incorporated on this little record card, the face side giving all details about matter sent out, and the reverse side giving an accurate line on replies and sales which result.

At the end of the month the figures from all cards filled out during that month are taken from the cards and entered on ledger cards, one of which is kept for each territory. From these records it is simple to get a complete summary and a total on the amount of matter sent out from month to month and year to year. These figures are later incorporated in a comprehensive, summarized report which is submitted monthly by the advertising manager to the board of directors.

Record of Magazine Advertising

It is important that an accurate, definite record be kept of contracts with publications. One card is made out for each publication, and where a large list is used the cards can be filed either alphabetically by name of publication, or by name of city.

One form gives a definite record of the contract, and matter sent to the publication, another gives a definite record of sales. One of these cards is made out for each publication and space is provided for orders received on each day of the year, the card being printed two sides. The summaries at the bottom are of unusual value to the advertising manager who aims to keep an accurate line on his work.

XIV. The Facts that Must Govern Advertising[1]

By H. Tipper

Advertising and sales are so intimately connected, being, in fact, only different phases of one business operation, that it is impossible for the advertising manager to look at the possibilities of a field entirely from an advertising standpoint; and it is obvious that in considering any aggressive selling campaign, either with or without advertising, the following points necessarily require illumination in order to determine the most economical method of handling the business.

The points are: —

The capacity of the plant involved.
The consumption of the article in question.
The number of competitors in the field; and, consequently,
The total amount of business which can be secured.
The present consumption in relation to the total possible consumption.
The increase in the consumption each year during a series of years up to the present.
The consumption in the different states or zones which may be of interest from a selling standpoint, showing best and worst from the total consumption.
This consumption balanced against the square mileage involved.

[1] *Printers' Ink*, December 28, 1911, pp. 10–12. Reprinted by permission of *Printers' Ink*.

The number of dealers who would handle this article — if it is to be sold through dealers.

Present distribution of the material in question.

The present market price of competitive articles.

The total amount of money involved in business, considering the consumption.

The total amount of money involved, considering the percentage of present consumption which could reasonably be expected.

The total profit involved in this amount of business; and, consequently,

The total amount of advertising and selling expense which could be absorbed in developing the business.

It will be seen from this array of the factors entering into the case that the advertising manager, in order to be in a position to decide on the extent, the method and the reason for advertising, must be familiar with the conditions from all selling standpoints. Otherwise, the plan of advertising decided upon may have only a comparatively small relation to the sales effort and conditions.

It has been unusual, even in the selling department of any business, to develop all, or nearly all, the factors which are expressed above, and, as a natural consequence, a large amount of money is being expended every day in experimentation upon a market regarding which the facts are already developed.

The usual plan in by far the majority of cases where it is decided to market a new product is to start a few salesmen on what would appear, from a personal impression or general knowledge of the trade, to be the most important markets and feel the thing out in this way. An expenditure of $20,000 to $50,000 is easily absorbed in this experimentation without developing such information as would form the basis for an examination into the possible efficiency of selling and the possible profit to be secured.

Personal impressions, even those of one or two men who have been brought up in the industry, are easily misled, by appearances and local conditions through restricted fields, into an entirely wrong conception of the market and the methods to be adopted in covering that market most efficiently. In working out a case a few years ago, the writer was particularly struck with this condition.

The plant in question had a capacity which was considered by the experienced sales manager to be quite small. It was also con-

cluded by this gentleman that $15,000 or $20,000 could be spent for advertising this particular output in addition to the organization of a considerable sales force.

Knowing very little of the trade conditions in this field and being impressed with the lack of statistics on the subject, the writer made an investigation which was carefully carried out into the possible market along the lines in which it was proposed to sell the article in question.

This investigation showed: (*a*) that the personal impression or judgment of the sales department was utterly at fault and that the writer's judgment was equally out of line with the facts; (*b*) that the total consumption of the article in question in the field proposed did not absorb more than one-fourth or one-fifth of the capacity of the plant, and anywhere from one-eighth to one-tenth of the amount expected; (*c*) that the cost of the advertising and sales organization proposed would have been entirely out of line from the standpoint of possible consumption within the near future.

While this was an unusual case, on account of circumstances in the industry involved, which made the apparent importance of the business much greater than there was any warrant for, it showed conclusively the necessity for investigation of the trade conditions in order to form a reasonable basis for the formation of a selling plan; and inasmuch as advertising is a part of the selling plan, the same necessity arose in the determination of the extent, method and conditions of the advertising.

Apart from such an unusual condition as this, the excessive cost of selling, due to promotion and sales work, covering fields and methods which the consumption of the articles would not warrant, has just as much to do with the difficulties in many organizations as the over-capitalization of physical properties.

I have in mind a plant in the Middle West where, although the business had increased to the extent of requiring double the capacity to fill it, the waste of efficiency in selling and the consequent enormous promotion expense made it impossible for this firm to realize sufficient profit to pay a dividend.

It is well known that usually the expense of marketing equals 100 per cent of all the other factors entering into the cost of an article, and in quite a number of cases the proportion is even greater.

This being so, it is evident that, in order to approach the question of marketing any particular material, it is necessary that the basic information should be at hand. This should be arranged in such shape that an intelligent investigation can be made with a view to approaching the marketing of the product with a high degree of efficiency.

It may be contended that the advertising manager, dealing with only a portion of the selling question, is not interested in the development of a number of these factors. It is true that the development of most of the factors should naturally fall upon the head of the sales department; but it is just as true that, as a rule, the advertising manager is in the best position to make such investigations and secure the information along these lines. Except in the notably efficient selling organizations which stand out as unusual monuments of efficiency, the sales manager has been a successful salesman with a turn for executive management. For a number of years selling has been to him a succession of individual deals and the general marketing has been the result of these.

As a matter of fact, precisely the reverse should be the case if the subject is properly approached. The individual deal and the success of this deal is the result of an intelligent marketing scheme.

Furthermore, the sales manager has been commonly limited in his viewpoint by the necessity for showing a certain amount of sales within a specified period (say six months or one year) at a certain percentage cost of selling. This has the effect of preventing him — unless he is unusually far sighted — from viewing the marketing scheme over a series of years and having in view rather the ultimate effect than the balance in his favor over a short current period. Too much advertising has been done without previous investigation of trade conditions and requirements, and too much money has been wasted on that account.

XV. Finding the Weak Spots in General Publicity[1]

By Floyd Y. Keeler

Any manufacturer of an article of common utility which has attained practically perfect national distribution is continually confronted with the problem of purely local conditions, operating sometimes without evident rhyme or reason, either in favor of or opposed to the current of sales.

For instance, a city like Cleveland may be a good town, and the whole state of Ohio may be going well, but somehow, next door, in Indiana, sales may never have been quite as large as they ought to have been. Or again, sales may be gaining volume in Massachusetts, while in Boston itself they seem to be going back.

To paraphrase a well-known saying: You can hold some localities all of the time; you can hold all localities some of the time; but you can't hold all the localities all of the time. No matter how meritorious and even superior the article may be, there will be places where sentiment will slump from the highest popular approval and patronage to the blankest indifference, or even to actual, if undeserved, ill repute. And, conversely, the other way around.

The causes of these fluctuations comprise an infinite but highly entertaining variety. The unscrupulous competitor who taints a whole district with insidious libels; outbreaks of price wars where dealers seize on justly popular advertised specialties, cutting the whole local market from under them; the legitimate boom which often develops for a similar (just as good) article of local manufacture to make it the local fashion; such specific causes could be catalogued page upon page. Then there is the natural ebb and flow which always characterizes demand, due to more subtle and not so easily get-at-able causes. And there are also the utterly unresponsive territories where the backward local conditions are fundamentally unfavorable to creation of demand.

There are undoubtedly many lines in which it is a highly successful and constructive policy to let advertising immediately

[1] *Printers' Ink*, May 1, 1913, pp. 17–22. Reprinted by permission of *Printers' Ink*.

flow into areas of sales depression, in order to reclaim them to a point of maximum volume. But there are perhaps a far greater proportion of enterprises where it pays better to ride with the strongly favoring tides, leaving the unprofitable sections to reach a normal balance, supported by enough national advertising to keep them moderately active, and when the unprofitable period has passed be sufficient to increase sales materially; or until the unprofitable section in question shall be reached through the medium of a small surplus appropriation available for use locally.

Given such conditions, it was entirely possible to advertise largely where, for some local reason, it did not pay, and on the other hand, a very small proportionate expenditure might be made where all the conditions were entirely favorable for a large immediate increase in sales. It is manifestly bad judgment, even to the point of being foolish, to spend $1,000 in advertising in a community where the total sales were only $1,500, and equally absurd to spend only $50 in the same community.

About two years ago the writer decided to make a definite analysis of the facts and figures at hand to ascertain the amount spent in each town to sell a dollar's worth of goods.

Or, to state it differently, the percentage of the sales in each community represented by the money spent for advertising in newspapers reaching that community.

Finding the Net Cost of the Advertising

In order to arrive at that conclusion, it was first necessary to secure the following information: —

1. In what towns are sales made? What sort of towns are they: manufacturing centers, mercantile, farming, railroad, etc.? What is the population? Who are the dealers?

2. The sales to each dealer for five years back. The sales for the current year as compared with the average sales for five years.

3. Newspapers used in each town. Combined circulation of papers. Net cost of advertising in the town.

The net cost of advertising divided by the net sales will give the per cent of advertising cost for the locality — the number of

cents the company spent there during the current year to sell a dollars' worth of tooth powder. The five-year sales figures will show whether the market is improving or the reverse, and will indicate any abnormal conditions which may need to be investigated separately.

TABULATION SHOWING ADVERTISING COST PER DOLLAR OF SALES

ANY STATE

Population 1,500,000

Town	Class	Population	No. gross 1907–12 yr. gr.	Average no. gross 1907–12	No. gross 1911	Papers	Circulation	Net cost adv. 1911	Net sales 1911	Per cent
Waynesville......				11	10	Times	6,966	$46.69	$205.20	.227
Capital Drug Co..	Mfg.	23,975	'07 10			Record				
			'08 5							
			'09 ..							
			'10 5							
			'11 5							
Davis and Co.....			'08 10							
			'09 5							
			'10 10							
			'11 5							
Norwood........				23	15	Gazette	17,965	95.88	307.80	.246
Schaeffer and Co..	Mfg.	45,941	'10 15							
			'11 5							
Norwood Dr. Co..			'07 25							
			'08 20							
			'09 25							
			'10 15							
			'11 10							
Redington.......				7	5	....	....	....	102.60	....
Hover and Co....	R.R.T.	29,536	'07 10							
			'08 5							
			'09 10							
			'10 5							
			'11 5							
		99,452		41	30		24,931	$122.57	$615.60	.199

Much of this information was compiled from jobbers' records. It was no small task, but it was finally collated and tabulated on sheets, showing the entire country by states and towns. The result showed the percentage of advertising cost for each town, and for each state by totaling the columns. The accuracy of the whole was tested by adding the state totals into a grand total

and comparing with the ledger records of total sales and total advertising expenditures.

The accompanying chart is a section of a page from the record, with fictitious names. In the first column is the name of the town, with dealers' names directly underneath. The classification of the town follows, with its population. In the next column follows the number of gross bought by each dealer, year by year, for five years. Then comes the average number of gross for five years bought by all dealers in the town, and the total amount for the current year. The four columns following need no explanation, and the last gives the advertising cost per dollar of sales in each town.

Summarized briefly, the chart shows that in "Waynesville," a town of 25,000, sales of $205.20 were made at an advertising expense of 22 per cent. In "Norwood," a town of 45,000, it cost 24 per cent in advertising to sell $307.80 worth, and in "Redington," a town of 29,000, $102.60 worth was sold without any direct expenditure in the town. The totals show $615.60 in sales for three towns, at an advertising expenditure of approximately 20 per cent.

Of course, the appropriation — a specific and non-elastic percentage of the last year's gross sales — was an indication of the amount that was available for the getting of new business, but this represented a lump sum and still remained to be apportioned all over the United States. With the recently obtained advertising analysis available, it was possible to figure with some degree of certainty the exact amount of money necessary to cover the entire country thoroughly by the use of newspapers — strengthening those points, like "Redington" in the chart reproduced, where no direct advertising was done, and cutting down the expenditure in those states and cities where the percentage was manifestly too high. It was found that to cover the United States adequately, a large increase in the number of newspapers must be made — a thousand at the very least. This would have meant a trebling of the appropriation, or cutting the size of the space to a point where it would be almost negligible.

The logical thing to do, therefore, was to select a list of magazines for use during 1912, so that, having used newspapers alone and magazines alone, the strong and weak places in both plans could be compared, with the idea of supplementing one medium with the other wherever it was possible to do so successfully.

At the end of 1912 a chart like the second one reproduced was made out, showing the percentage of advertising cost per dollar of sales, just as was done in 1911. This last chart, of course, covered

APPORTIONING MAGAZINE CIRCULATION ACCORDING TO SALES

ANY STATE

Population 2,100,000

Town	Sales aver. 5 yrs.	Sales aver. 1912	Cash sales 1912	City circulation, magazines	City advertising cost, magazines	City per cent	Rural cir., magazines	Rural adv. cost, magazines
Littleton.....	40	60	$1,231.20	16,131	$126.79	.103	79,832	$627.48
Salisbury.....	38	60	1,231.20	7,400	58.16	.047	....	....
Rockland....	50	65	1,333.80	4,754	37.37	.028	....	....
Freeport.....	5	15	307.80	1,258	9.89	.03	....	....
	133	200	$4,104.00	29,543	$232.21		79,832	$627.48

	29,543
	79,832
Total state circulation	109,375
Total state advertising cost	$859.69

Divided by $4,104.00 cash sales equal 20.9 per cent total state advertising.

the same territory as the 1911 chart, while practically the same merchandising conditions obtained. One chart shows the results of newspapers alone and the other those of the magazines alone. A careful comparison of the two, state by state, city by city, shows up the weak spots and tells at a glance where it is necessary to supplement general (national) magazine circulation with (local) newspapers.

It will also be noted on the magazine chart that there is a distinct ratio existing between the state population and the state circulation, but more particularly between the city population and the city circulation in the newspaper chart. Therefore, as

one circulation is really a part of the total state circulation, the logical thing to do on a nationally distributed article is to combine the two kinds of circulation to produce a maximum result.

The whole problem, after all, is to eliminate waste circulation and its natural corollary, the ill-advised expenditure of the appropriation.

The final results obtained should be the spending of an advertising appropriation a good deal more effectively than is the case in the ordinary concern with national distribution where the article is handled by jobber and dealer.

XVI. Using Buyers to Find Out How to Reach Prospects [1]

By Roscoe C. Chase

Very little definite information regarding the exact newspaper situation in our larger cities is in the possession of national advertisers. In fact, there are very few advertising agency space buyers who understand the true situation in many of the larger cities.

The idea of investigating the true circulation condition was suggested to me recently when sending out orders for a considerable amount of daily newspaper advertising. I thought to myself: "What if the general manager should come to me and ask why I am spending money in any one of these papers. I could tell him different facts regarding a number of them, but on the great majority I am taking the word of some one else, and that word may be merely an individual opinion based on fact or prejudice." From that minute on I have made an earnest endeavor to investigate every publication of any consequence in which we are advertising.

Every one of the larger cities has one newspaper which is always head and shoulders above all others for reaching the great middle class. This paper is usually acknowledged as preëminent by the other publishers, and most of them make strong claims for second place.

[1] *Printers' Ink*, February 20, 1913, pp. 70–72. Reprinted by permission of *Printers' Ink*.

This makes it very difficult to come to a definite decision with regard to the standing of the second, third, fourth, etc., especially when each of these papers is employing the best space-salesmen money will buy. Ofttimes the weakest has the highest-priced salesmen, and carries considerably more advertising than some which are entitled to it on account of the value of additional circulation and the quality thereof.

In some cases the advertising manager knows the conditions, but is powerless to control them, owing to personal favors of the salesmen. I have often heard such advertising men remark: "That man ought to be on our salary list, and the least I can do is to give his paper some of our advertising appropriation." Usually, however, such a salesman works in over the head of the advertising man, and it is not in his power to refuse to use his paper.

With all this in mind it is interesting to note the result sheets of our recent poll among Packard owners in the larger cities, with reference to the newspapers they read regularly. Many new suggestions are arrived at as we look over these return slips and figure out the various angles at which results leading toward definite knowledge of the exact situation from our viewpoint are revealed.

There is a great deal more information to be gained than we at first anticipated, and it seems to me that it will be of great advantage to all nation-wide advertisers to take up some similar method of investigating the advertising situation in so far as it applies to their own product.

Our investigation has been solely from the viewpoint of selling a high-priced motor car of exceedingly good quality, and while the results would apply to the manufacturer selling an equally good piano, phonograph, etc., the figures would be of small consequence to one selling an article of general consumption among the masses. Still some similar plan of investigation could be worked out to excellent advantage by every national advertiser with the object of securing the best results for money expended.

My latest investigation has been among the daily and Sunday newspapers. In each of the larger cities this investigation was

carried on in such a way as to get the most out of it. To a certain number of owners in each city I sent a list of all the papers published, and when the paper was published both daily and Sunday I made two entries, and when it was morning, evening and Sunday, three entries. No letter was enclosed but a simple request of what was wanted was multigraphed at the top of each list, with which was enclosed a return stamped envelope.

In a large Eastern city, reports from 124 Packard owners show that they read a total of 699 newspapers. Dividing this into daily and Sunday I find that 235 are Sunday papers and 464 daily papers. Dividing the dailies there are 241 in the morning field and 223 in the evening.

At first it seemed strange to me that the three fields were so evenly balanced, but on going into the matter deeper I finally concluded that it was not such a hard problem as I had originally imagined. Each of the 124 Packard owners reads an average of nearly two papers in the morning, two papers in the evening, and two on Sunday.

Owing to many dealings with Packard owners I have discovered that the average is a business man fairly well fixed financially, and sufficiently able mentally to value the very best article in any particular line regardless of the price. If such a man were to tie himself down to the opinion of one great editor or one paper, it is only natural to suppose that his opinions and judgments would be sorely hampered. Instead of that he is big enough to realize that he must see the best two papers, morning, evening and Sunday, that his opinion may be properly reasoned out considering the situation from the viewpoint of the several editorial staffs.

You and I in the advertising business who perhaps read a great many papers are surely wise enough to know that many situations are explained very differently in different papers. Some publishers refuse to publish information about certain transactions or dealings, whereas others play them up strongly.

In a certain Western city, I found 113 owners reading a total of 514 papers. While each man in the Eastern city reads an average of nearly six papers, it seems that the average in this Western city had dropped down to considerably less than five.

As divided between morning and evening papers, the report shows the following result: morning 188, evening 149, Sunday 177. The majority read two morning and two Sunday papers, but it is only about every other one or less who reads two in the evening.

By using two morning and one evening in the Western city we can reach 95 per cent of the owners once, and about 80 per cent twice, and 50 per cent three times.

The situation in a second Eastern city proves somewhat similar to that in the West, excepting that the distribution of papers seem to be a little more than five to each owner.

In one city where it has been our desire to advertise very extensively and thoroughly, we have in the past used six newspapers, including daily and Sunday. In checking over each of the slips sent in by Packard owners from that community, I find that by using two evening papers and one morning paper I can reach 97 per cent of the owners. Eighty-five per cent of them are reached by two papers and about 60 per cent by all three.

There is surely a remarkable discovery on our part, and no doubt we can make our next campaign much more profitable by sticking to these three papers and perhaps increasing the space one-half. This will prove less costly, and after carefully considering all other features we believe it will prove a much better advertising venture on our part.

It is our intention to go over each slip sent back to us by Packard owners, and consider it from every possible angle which may be of advantage to us in the selecting of the papers in which we advertise.

The average individual who owns and operates a Packard car or who is in the position of one we would term a good prospect is an active business man or woman having mental intelligence and standing above the average. If a fairly representative number of these individuals read a certain paper or number of papers each week, daily and Sunday, we feel confident that those friends and business acquaintances with whom they are daily associated must follow a somewhat similar routine.

It therefore seems reasonable to us to believe that if we are reaching 95 per cent of all Packard owners in one community by a

certain combination of papers that we can reach approximately the same general percentage of prospective owners with the same combination.

XVII. How Packard Investigated Quality of Circulation [1]

By Roscoe C. Chase

Duplicated circulation among newspaper and magazine readers and its value to national advertisers is the subject for many discussions. To determine the exact amount is not so difficult if one takes the time and trouble to investigate it.

In reading the facts submitted regarding my recent circulation investigations, keep in mind that to advertise Packard motor carriages properly it is necessary that we reach primarily three sets of individuals. First, the man or woman who has the wherewithal to own and operate such a car; second, those who comprise their associates and friends, being associated with the first class at social functions, clubs and in business; third, those who act as business assistants, associates and friends of the second class. Often the persons comprising the third class are in direct touch with those of the first, although they stand in much closer relationship with the second class than they do with the first.

If it were necessary to reach only those in class number one, we would save money by securing their names and addresses and concentrating our solicitations by personal salesmanship and by mail. We must also reach classes two and three, as much of the buying is done on the recommendation and approval of those who desire but can't afford what we have for sale.

In compiling results from our inquiries we believe the percentage of each class reached by a given newspaper is about equal to the other two classes. That is if we are reaching 95 per cent of the Packard owners with a certain combination of newspapers it is safe to believe we are reaching 95 per cent of their friends and associates with the same papers. Class three read largely the

[1] *Printers' Ink*, July 10, 1913, pp. 17–20. Reprinted by permission of *Printers' Ink*.

same papers, although we believe from observation they read other papers in addition.

It has proven most interesting to figure out the best grouping of the newspapers to accomplish the greatest efficiency for the least amount of money. This is the result desired by every large manufacturer who is advertising to create that general publicity effect which is so desirable.

Each of the lists returned has been gone over carefully, figuring the various newspaper combinations, duplications, etc. The result gives us not only the relative standing of the newspapers, but also makes it possible to figure out just how many times we reach a given reader by using certain newspapers.

In some cases we accomplish great efficiency by using one morning paper and one evening paper. In others we must use a combination of three papers and in the very large cities a combination of four or five papers seems advisable.

As an illustration, I will give the results as figured recently on 494 replies from New York City. Three hundred and eighty of these replies were from Packard owners and 114 from members of the New York Stock Exchange, not Packard owners. The Stock Exchange members were written after we had heard from Packard owners. Certain newspapers advised us that we had not given them a fair chance, as we had never advertised in their papers, and therefore we couldn't expect to find many Packard owners among their readers. Regardless of this the result of the investigation among non-owners proved almost identical with the exception that two papers received a little increase, probably due to special Stock Exchange news which they publish daily.

In going over the results to obtain the greatest benefit for the least money, I have carefully figured all the various combinations, including two papers, three papers, and four papers. As a result the most efficient combination seems to be what I have termed the "Big Four." In other words, I can take two morning and two evening papers and by advertising in all four reach 96 per cent of the owners and prospects in New York City and suburbs, reaching many of them two, three, and even four times.

To illustrate this, I will go over the resultant figures, using numbers instead of names to indicate the papers. In the following table No. 1 and No. 2 represent morning papers and No. 3 and No. 4 evening papers. I have tabulated the results on the 494 returns and the figures represent the number of people who read the various combinations. I might add that one of the morning papers is a Sunday issue, for I find that the Sunday issue of this paper is read by more people of the class we desire to reach than the daily issue, while in the case of the other morning paper the daily edition has a considerable advantage over the Sunday.

No. 1, No. 2, No. 3, No. 4	24 read four papers	
No. 1, No. 3, No. 4	23	114 read three papers
No. 1, No. 2, No. 3	43	
No. 1, No. 2, No. 4	31	
No. 2, No. 3, No. 4	17	
No. 1, No. 2	35	193 read two papers
No. 1, No. 3	60	
No. 1, No. 4	35	
No. 2, No. 3	37	
No. 2, No. 4	22	
No. 3, No. 4	4	
No. 1—65		145 read only one paper
No. 2—40		
No. 3—23		
No. 4—17		
	18	read none of the four
	494	Total

You will notice that by using the four papers we reach all but 18; that is, we reach 476 out of the 494, or an efficiency of over 96 per cent. Three hundred and thirty-one or 67 per cent are reached two times; 138 or 38 per cent three times, and 24 or 5 per cent four times. Figuring this further, we find that we place a Packard advertisement before the 494 people 969 times or an average of close to two times for each individual.

Now, most any combination can be arranged from the above table. You can find what efficiency is obtained by any one paper,

what efficiency by using two morning or two evening or one morning and one evening, or by using any three. If you take into consideration the rate per line for the advertising, you can discover your best bargain combination. Some argue that a list of 494 is not enough to judge from and to know definitely would necessitate a reply from every man of sufficient financial standing to own and operate a Packard car.

To decide this question our results were tabulated in sets of 126 and each of these sets was compared with the other two. The comparison is close in so far as each paper is concerned and the Stock Exchange returns check up very closely with each of the three sets of owners.

Showing of Different Combinations

Now, I wanted to know what efficiency would be obtained by three papers and so I took paper No. 1, which reached more of the informants than any of the others, as a basis and figured the several combinations it makes with two of the other three. Taking Nos. 1, 2 and 3, I find that we reach 459 out of the 494 or 93 per cent. We reach 270 or 54 per cent two times and 67 or 13½ per cent three times. Using the combination of Nos. 1, 2 and 4, we reach 453 out of 494, or approximately 93 per cent once; 271 or 54 per cent two times and 55 or 11 per cent three times. Now, this second combination costs us four cents per line more than the first combination, and there is so little difference in the figures that it would seem advisable to use the cheaper combination. The third combination made would use papers Nos. 1, 3 and 4; that is, one morning and two evening. With this combination we reach 436 or 88 per cent; 237 or 48 per cent are reached two times and 47 or 10 per cent are reached three times. This combination is considerably cheaper than either of the other two, costing ten cents per line less than the second combination and fourteen cents per line less than the first.

Opinions differ with reference to the value of evening papers as compared with morning papers. If the weight of opinion seems

to be in favor of the evening papers, then here is a chance to use 88 per cent efficiency at from ten to fourteen cents per line less than the 93 per cent efficiency.

This illustration of one newspaper situation will give you just a fair idea of how interesting it is to carry a newspaper investigation to such length as really to feel that you know you are getting the best distribution at the lowest cost. At almost every turn in your calculations you are confronted with new and surprising facts. You can branch off from an investigation of this kind at most any place and find many new ideas for consideration. In almost every locality the circumstances and conditions are so different as to add new interest.

As an example of such circumstances, compare the newspaper situation in New York with that in Boston. In New York the figures show that the average man who is financially able to own and operate a high-priced car reads regularly an average of almost two morning, two evening and two Sunday newspapers.

In Boston our tally sheets show that while they read two morning and two evening newspapers, there is an average of less than one Sunday newspaper to a Packard owner's household. That is the only circumstance of this kind which has so far confronted me in the investigations in the many cities where we have taken the trouble to find out the exact situation. In the smaller cities we can cover the field quite thoroughly with two papers, reaching a majority of the owners with both papers. In some cities it is necessary to use three or four papers, as the circulation seems to be very much divided with a smaller percentage of duplication.

In Chicago, for instance, if we were to cover the evening field it would be a case of using three evening papers, because the percentage of the duplication between the evening papers in that city is very small, there being something like 25 per cent who read more than one evening paper regularly. According to our results, the most economical method of covering the territory seems to be the use of one or two morning and one or two evening papers.

XVIII. The Worth of Various Plans to Produce Circulation[1]

By George O. Glavis

Subscriptions induced by premiums must not be confused with the prize and rebate offers made to canvassers. The latter represent compensation for work performed, while the former go to the subscriber as an inducement, additional to the value of the periodical itself, for subscribing.

Premium subscriptions are in all cases looked on with suspicion — often merited — by the Post Office Department. They are not, however, excluded from the subscription list, provided the subscriber has been required to pay, in addition to not less than 50 per cent of the subscription price of the magazine, an amount equal to the full retail selling price of the premium. That does not refer to the cost of the premium to the publisher, but the price at which the subscriber could buy it at retail.

Under that rule the department accepts as legitimate a subscription for a premium selling at retail for $5.00 and a magazine with a subscription price of $2.00 a year only if the subscriber paid at least $6.00 for the combination. The fact that the publisher might obtain the premium for much less than the retail selling price would have no bearing. Of course, there are many cases in which this provision is evaded, and subscriptions are, in effect, given away to purchasers of merchandise, which in its turn has been offered at a very low price compared with its regular retail selling price. That is one of the many abuses of the second-class mail regulations which could readily be corrected should publishers or others report the violations to the department. It is a class of circulation of the most objectionable character, and the fact that such practices exist makes it incumbent upon space buyers to scrutinize carefully all premium circulation.

At the same time it must be remembered that there are many publications with which the offer of a premium is in no sense objectionable. That is true in the case of periodicals circulating to young or otherwise untrained readers, whose interest it is

[1] *Printers' Ink*, August 21, 1913, pp. 65–72. Reprinted by permission of *Printers' Ink*.

necessary to catch by an appeal which they will most easily understand. When that is accomplished by the publisher a large percentage of these subscribers may be depended upon to become interested readers and consequently valuable to the advertiser. Furthermore, there are various conditions under which premiums given with some publications not only assist in obtaining the subscriptions which the publisher needs, but also create an interest in the publication which the subscriber might not otherwise feel. Particular reference is had to premiums which must be used in connection with the text matter in the publication — such, for instance, as patterns, cook books, plans and other things which are explained by or in some other way bear a specific relation to the text.

The number of premium plans is so great that it is impossible to devote much space to explain them here. In valuing subscriptions obtained in this way, however, all of the conditions should be ascertained and considered in connection with the periodical itself. It is especially necessary to consider the class of people to whom the magazine and the premiums are expected to appeal. As a general proposition it is safe to begin such an inquiry with the idea that such subscriptions do not represent full buying power for the advertiser. It will be safer to work away from that theory than to accept the value placed by the publisher on premium subscriptions and work toward it.

In the case of newspapers conducting vigorous subscription campaigns with furniture and similar premiums as the bait, it will undoubtedly develop from an inquiry that, with the majority of subscribers, the paper itself was given little or no thought, but that on the contrary they bought the premium and accepted the paper as one of the incidental features of the transaction. This will be found to be fairly well substantiated by the number of cancellations of such orders. It is due to the fact that offers of this kind do not appeal to those who are really interested in the news, but to a class which reads newspapers at infrequent intervals. When they tire of the premium or feel that the instalments are an unnecessary burden, they cancel their order without thought of the paper.

A class of subscriptions which may be regarded as at least similar to those induced by premiums are those sent in by "club raisers" — those pests by whom we are all more or less annoyed at times. While it is true that these subscribers receive no premium, the "extraneous inducement" is present in the person of the "club raiser" — usually a friend of the subscriber, or at least some one the subscriber desires to help or encourage. These club raisers are given merchandise or cash for their services and also, in many cases, a free subscription for themselves.

The majority of subscriptions induced in this way represent persons who subscribed to help some one or something and not through any desire for the periodical. It is perhaps needless to point out their lack of value to the advertiser.

Gift subscriptions — those which are paid for although not by the recipients of the periodical — are, fortunately, a class which is confined principally to religious and educational and other similar publications, to which different standards of value apply from publications in other fields. In many cases these are gifts of single subscriptions between friends, while in others they represent a quantity of subscriptions paid for from a common fund, such as those paid for by a Sunday school for its pupils. In such cases there is no good reason for objecting to this kind of subscription.

When the subscription list of a general, or trade or class publication contains a considerable percentage of these gift — or free to the recipient — subscriptions it should be given the most painstaking sort of an examination. As a general thing, "the reason" will be found to be one or more advertisers wishing to direct the special attention of certain persons to their product, and they look on the periodical as better than a direct appeal and the most diplomatic means of accomplishing that object. The persons whose names they send in as subscribers are already, to some extent, in touch with their products and the subscriptions are a courtesy which tends to increase their interest. Manifestly, however, such circulation is prejudiced — perhaps unwittingly — against the goods of the advertising competitors of the donor and does not represent the kind of buying power for which they should be expected to spend their advertising money.

Furthermore, when circulation of this kind is accepted in large quantities it would seem to indicate a lack of demand for the periodical by those readers from whom the advertiser should look for returns — an editorial weakness, perhaps — or else that it is dominated by one or more advertisers — naturally to the detriment of others. Under either condition such circulation should stamp the publication as one of questionable value to the advertiser. While these gift subscriptions in small quantities may properly be considered good circulation, it is none the less a safeguard to make sure of the conditions under which they are obtained before giving them 100 per cent value.

One case of gift subscriptions of a particularly — and fortunately, unusually — flagrant character was of a periodical established some years ago in New England. Its circulation grew so very rapidly that the postal facilities at the mailing office were taxed beyond capacity. Inquiry developed that the publisher had hit upon the very simple plan of having certain manufacturers give away with each sale of their product a coupon calling for a $1.00-a-year subscription upon presentation of the coupon and the payment of ten cents. This plan appealed so strongly that the circulation of the magazine quickly reached the million mark and, what is much more remarkable, advertisers were paying real money for that circulation. It is well for those space buyers who look only to the "total guaranteed circulation" that the publication in question is no longer in existence.

It will indicate the extent of this particular kind of abuse of the second-class mail privileges, to say that the department found it necessary to place in the form of application for second-class entry a question asking the number of such subscriptions which were included in the list. When the quantity was as great as 10 per cent of the whole, special inquiries were made to ascertain the facts concerning them. It frequently happened, as a result of these inquiries, that such a close connection was established between the publisher and advertiser, or others paying for the subscriptions, that entry of the publication was refused on the ground that the facts concerning this one class of circulation

proved the publication was "designed primarily for advertising purposes or for free circulation," or both, and therefore not admissible under the law.

It is, of course, to be understood that in some cases of this character the publisher receives payment only indirectly, in that the giving of the subscriptions is made part of the advertising agreement, and the only payment actually made is that for the space. When arrangements of this kind are entered into between a publisher and an advertiser, their entire want of equity will be understood when it is pointed out that similar concessions are not made to all advertisers but only to a favored few — those, for instance, with whom it is hard to close and to whom, for that reason, the publisher offers the subscriptions as an extra inducement.

The variations of this class of subscriptions were so great at one time that the department had twenty-eight different rulings affecting them, all of which had to be made from time to time either to meet actual conditions which were found or to conform to the pressure brought to bear on the department by the publishers affected.

Expired subscriptions represent another important circulation question, and many views are expressed for and against the practice adopted by some publishers of carrying such names on their subscription lists.

Until about six years ago the Post Office Department had not promulgated any definite ruling to govern the length of time after expiration during which such subscriptions would be recognized as a permissible part of the list of subscribers which the law requires for a publication mailed at the second-class rates. At that time the department modified the regulations and held that "unless subscriptions are expressly renewed after the term for which they are paid within the following periods: Dailies within three months; tri-weeklies within six months; semi-weeklies within nine months; weeklies within one year; semi-monthlies within three months; monthlies within four months; quarterlies within six months, they shall not be counted in the legitimate list of subscribers."

That amendment to the postal regulations brought forth a storm of criticism which was heard in every Congressional district in the land. It came principally from those publishers who held names on their lists until all arrears were paid and the publications ordered stopped. Until the promulgation of that order by the department there were many publishers whose subscription orders were on a " till forbid " basis, and many of them, rather than take a chance of losing a " subscriber," carefully refrained from doing anything, such as sending out a bill, which might raise any question in the mind of the subscriber as to whether or not the publication was still wanted.

Protests were also made against the ruling by certain publishers who object to any action on the part of the Government which they feel might be construed as an attempt to curtail the much-talked-of liberty of the press. Others objected because they could not understand how the department arrived at the credit periods for the several frequencies of issue, and so far as is known, this information has never been disclosed.

The criticisms finally developed sufficient strength to induce the department, in 1911, to modify its ruling so that at this time a publisher may give credit for one year regardless of how often his publication is issued.

So far as the Post Office is concerned, the above explains what may be done in the matter of expired subscriptions, but the propriety of the practice of carrying names after the expiration of the paid-for period, except in certain extraordinary cases and under special conditions, is a debatable question, and, like many other circulation questions, depends upon the publication itself and the conditions surrounding its distribution.

One of a series of subscription renewal letters sent out by an old established industrial paper contains some interesting statements concerning the propriety of carrying names on the list in the absence of instructions to renew, and frankly, the statements are opposed to my point of view. This publisher states that if he had cut off on January first all subscriptions which expired with December he would have been put to an expense of $5,000 to restore the names of those who renewed within three months.

With respect to that statement it might be pointed out that $5,000 will pay for many changes in a mailing list regardless of the system used. Assuming that the expense would be two cents per name, that sum would represent the restoration to the list of 250,000 subscribers. If the percentage of renewals in the three months was 50 per cent, then half a million subscriptions must have expired in December. Such a number undoubtedly represents a considerable portion of the whole list and suggests the advisability, as a measure of economy and precaution, of a readjustment of methods so that the expirations throughout the year would be distributed, as nearly as is feasible, to make a like number expire each month, rather than to have the bulk of the expirations occur in any single month. Such an arrangement would make it easier for the subscription department to handle the list and also would enable the publisher at any time to change his practice, should he so desire, and remove names immediately upon expiration, without creating an abnormal decrease of circulation in a month of such importance as the first one in the year.

This publisher, however, is unquestionably well within his rights in his present methods, and the only question for him to decide seems to be whether or not the list, with such a number of unpaid subscriptions, is to the fullest extent productive to the advertiser. On the other hand, the publisher may feel that to be a question which the advertiser should determine without his assistance.

As a matter of actual practice, though, the renewal of the subscription of an interested reader may, as a general thing, be obtained just as readily before expiration as afterwards — it is almost entirely a question of office methods. For that reason, to make a regular practice of carrying expired subscriptions seems to be a mistake.

The practice also has an undesirable effect on the readers because they all too frequently consider that they are under no obligation to pay for publications which they have not expressly ordered. Many of them are no longer interested but intentionally neglect to order the paper discontinued on the assumption

that their names will be dropped automatically. It follows, as a matter of course, that, not being interested, they are of no possible value to the advertiser and, feeling that it is being forced upon them, they probably develop an unfriendly feeling for the paper. Are not such names better off the list than on ?

There seems no justification for keeping them on, except a disinclination to make a material reduction in the mailing list, as that constitutes an important talking point for the space seller. Any advantage of holding such names, however, is offset by the expense and the fact, so often overlooked by publishers, that a strictly paid-in-advance subscription list is an argument second to none to the careful space buyer.

To the advertiser the practice of carrying expired subscriptions is necessarily objectionable and it is certainly unfair to include them, without the knowledge of the advertiser, particularly when the advertising rate is based on the size of the subscription list.

The only salable circulation is that for which payment has been made or promised, actually and not by inference. If expired subscriptions are included in the claimed circulation, the advertiser should ascertain, if not told by the publisher, what percentage they represent of the entire list.

An important point to be considered in connection with the auditing of a list carrying a material percentage of expired subscriptions is how they are to be accounted for in the audit so that no injustice may be done the publisher and also that the advertiser may be fully protected. Is the publisher to be given full credit for them without reference to the essential fact that they have expired, simply because the postal regulations allow the publisher to carry them for a year, or are the number and the length of time for which they are unpaid to be reported ?

It would seem important in such cases for the auditor to go back over the records of the publisher and determine the percentage of renewals and the percentage of persons who permit the publication to come for one or two or three months and so on up to the limit of a year before directing cancellation.

The number who cancel and pay for the fraction of the year during which the paper has been sent after expiration is also

valuable data. Such persons would constitute the part — the only part in fact — of the expired circulation for which the advertiser might reasonably be expected to pay without feeling that he was being mulcted.

It seems no more defensible to claim expired subscriptions as bona fide, when their continuance has not been requested, than to count as " sold " all copies furnished newsdealers for sale with the privilege of returning unsold copies — making no allowance for the number of copies to be returned.

As stated before, this question of expired subscriptions is a debatable one, and it is fully realized that the views expressed here will not meet with the approval of many publishers conducting their business on a strictly legitimate basis and giving full value to the advertiser. The opposition views would be of interest and should assist advertisers in reaching a conclusion on this subject.

XIX. Analysis of Newspaper Circulation [1]

By E. G. Pratt

What should the special representative furnish in his solicitation to manufacturers and advertising agencies, in the way of dependable facts?

Newspapers are the expressions of different personalities and they make different appeals. The agent who is in possession of all of the facts is enabled to make a more accurate choice between newspapers to be used in any given campaign. Competitive solicitation places the agent today in possession of many facts, but they too often come in the way of a knock by one paper upon another, and not in a constructive way.

We all know how interdependent newspapers, billboards, paint, street cars and all the other local advertising media are, and, although the newspaper is not expected to " close " business for the paint or street-car men, yet knowing his local field, he should, as many do, make it a part of the solicitation to impart his knowledge to the advertising agencies.

[1] *Printers' Ink*, July 2, 1914, pp. 73–74. Reprinted by permission of *Printers' Ink*.

Most large cities and many small towns have peculiarities of their own that make them react differently to the influence of local advertising. They differ from the standpoint of custom, of dwelling conditions, of social cleavages, of marketing problems, of retailing difficulties, of consumer preferences, of geographical conditions, any of which, if ignored, is likely to influence an advertising campaign. Following are some of the questions we would like to have answered:

First of all, how much net paid circulation?

It is hard for the publisher, who has long misquoted his circulation, to realize what would happen if, when buying his raw material, some 50 per cent of paper or presses were not delivered by the manufacturer. It is an analogous case when the circulation is not delivered to the advertiser.

Is the circulation guaranteed? How?
Is the circulation regularly audited? By whom?
How much gross press run?
Are unsold copies returnable?
How much of the circulation is urban?
How much suburban?
How much street sales?
How much R. F. D.?

We all recognize that after a certain point in a newspaper's circulation has been reached, the remainder has to be "sold." For this reason it's important to know:

How the circulation is obtained?
What percentage direct mailing, sample copies, premiums, clubbing offers, canvassers, crews, boys, partial payments, coupons, gift subscriptions?
With what other papers and to what extent does a paper duplicate?

From the viewpoint of editorial policy, we should like to know:

What per cent of men readers?
What per cent of women readers?
Is there a woman's page — on what day is it published — does it carry advertising?
Is there a sporting page?
Is there a financial page?
Is there a society page?
Is there a "want ad" page?
What special features, like a pure-food page?

With regard to quality of circulation:

What amount of advertising was carried in 1913? In the first six months of 1914? Amount of local display? Amount of exclusive local display — department store — automobile — financial — quality shop advertising — basement-sale advertising?

Also the amount of foreign advertising?

Amount of patent medicine advertising?

Which days of the week, taking a typical month, carried the most advertising of:

Department stores?
Grocery products?
Specialty shops?
Toilet goods?
Financial advertising?
Automobile and accessories?
Transportation companies?

Are local rates same as foreign?

What class of advertising is refused?

Is cash discount or agency discount paid to advertisers direct?

Classification of readers, according to occupation, if possible, would be of help.

Charts of cities showing rental divisions, according to whether the rentals are below $25 a month, between $35–$50 a month and over, and then give us the circulation in these exact districts.

Give a list of the advertisers who have used the paper consistently.

Give us information regarding the purchasing capacity of the reader.

Testimonials from local dealers regarding the influence of the newspaper to produce sales at retail stores.

The amount of advertising which dealers have paid for as a result of national campaigns of the manufacturer, and what help is offered the manufacturer or agent to secure local dealer advertising.

Analysis of the Field

Different cities and towns — Boston, Chicago, Toronto, Montreal, Yarmouth, Dallas, Montclair — have very distinct complexions, and so we are interested in:

The urban and suburban population.
The trading zone.
The geographical divisions and their buying tendencies.
The number of families — their nationalities.
Transportation lines — the distances from other cities.
Bank deposits and clearings.
Country trade — number of farmers.
How strongly the competition of mail-order houses has developed.
How much the chain store has become entrenched.
The number of industrial establishments and the number of their employees.
Advertised products which are manufactured locally.
Where the residential districts are — the manufacturing district — the retail district.
The local expenditure in canned goods — men's clothing — children's clothing.
Rules governing the sale of certain preparations; for example, those containing alcohol.
The number of department stores — their general character.
The number of drug retailers — of grocery retailers — of hardware retailers — of auto and accessories dealers.
A list of the important ones.
Number of jobbers in these lines — general character.
A list of the prominent ones.
The approximate amount of business done in each classification.

We could use to advantage a list of department stores in a city showing:

Name of paper pattern sold.
Those with toilet goods departments and the names of the buyers.
Grocery departments.
House furnishing departments.
Furniture departments.
Dress goods departments.
Wash goods departments.
Underwear departments.
Carpet departments.
Music departments.
Trunk departments.
Toy departments.
Shoes — men's, women's and children's.
Clothing — men's, women's and children's.

The department store in a city which sells the largest amount of:

Pianos and other musical instruments — cheap — high grade.
Toilet goods — cheap — high grade.

Groceries — cheap — high grade.
House furnishing goods — cheap — high grade.
Furniture — cheap — high grade.
Carpets — cheap — high grade.
Trunks — cheap — high grade.
Toys.
Dress goods.
Wash goods.
Underwear and hosiery — men's — women's.
Corsets.
Men's shoes.
Women's shoes.
Ready-to-wear dresses.
Woolens and worsteds.
Millinery.
Infants' wear.

One publisher in New York has just concluded a canvass of 1,000 stores in each of four lines, to determine the trade-marked articles demanded and the order of their sales. Another in Washington has worked out a comprehensive plan of coöperation between manufacturer and retailer, to increase the sale of goods advertised in this particular paper. A Philadelphia paper, through its promotion department, has rendered real service in its analysis of its city. Several Chicago newspapers have made a comprehensive analysis of Chicago's population and the newspapers' circulations.

XX. What the Advertiser Pays For [1]

By Roy W. Johnson

When the solicitor for a publication approaches the advertiser with reasons why his medium is entitled to a part of the appropriation, he is usually able to name a definite quantity of circulation. Quite frequently he is able to tell how much of it is in Kansas, or Oklahoma, or in any section of the country the advertiser may be interested in. Probably he can tell what proportion of the total is in cities of the first class, how much in cities of 50,000 to 100,000, and so on down to the rural districts. He has

[1] *Printers' Ink*, February 20, 1913, pp. 33–36; February 27, 1913, pp. 45–50. Reprinted by permission of *Printers' Ink*.

it nicely tabulated in plain figures, and it is easy sailing because he is dealing with definite, concrete facts.

But when he comes to the quality of his circulation, he at once begins to flounder. Perhaps he shows a bunch of letters from subscribers praising something the publication has said or done; maybe he produces a crop of claims of great results accomplished in some reform or other; once in a while he will demonstrate that 10 per cent of the subscribers are doctors, 2 per cent are preachers, etc. Occasionally he comes armed with documents signed by subscribers themselves, in which confession is made as to the amount of salary drawn by the head of the house, the make of bicycle ridden by the youngest brother and the player piano purchased by the rich uncle. This might be useful if there was any way to secure similar statements from all subscribers, and any means of insuring the truth of the returns, but there isn't in all the various kinds of evidence presented any reliable index as to the real hold the publication has upon all these doctors and preachers, etc. Mrs. Smith, of Smith's Corners, may or may not possess a talking machine, but how much confidence has she in what this publication has to say? The column rule which separates advertising from reading matter has no magic power to transform the mental attitude of the person whose eye travels across it.

The solicitor can give plenty of figures about quantity, but when it comes to quality he usually talks about percentages, or contents himself with oratory. Neither is any true index to quality of circulation, which is a term inclusive not only of the kind of people who buy the publication, but of the mental attitude they cherish toward it.

Yet the question as to which of two publications to patronize often hinges upon this very question of the quality of the circulations, and as a rule the advertiser's only recourse is to give the business to the solicitor with the best line of talk, or to judge by a study of the publications themselves and inquiry among other advertisers who use them. Now there is no better method of fooling one's self than the system of judging the value of an advertising medium by personal opinion of its contents. The man who is manufacturing scented soap may have a supreme

contempt for "slushy love stories"; and he may think the editorial policy of a paper absolutely idiotic; but what he thinks about it doesn't count. When it comes to selling soap, the only thing that counts is what its readers think about it.

Results obtained by other advertisers are hardly more reliable as a guide. A man can scarcely ask that information of his competitors, and the experience of those in different lines of business may be extremely misleading. A medium which pulled big returns for mail-order clothing might fall down seriously when it came to sending the reader to the local dealer for shoes. If the purchase of advertising space is ever going to be put upon a basis of anything like pure efficiency it will need a better standard of measurement than that.

What is wanted is a yardstick which will measure quality. We are requested to pay a certain rate for the advertising value of a certain publication. Is it a fair rate? We don't know until we have measured the value it is supposed to pay for. It is like a little problem in geometry: here is a rectangle which represents the rate. We are to construct a rectangle to represent the advertising value of the publication, and if the two rectangles coincide (within reasonable limits, of course) it is a fair rate. We have got the base of our advertising value rectangle in the quantity of circulation, but the altitude (the quality of circulation) is unknown.

Take as a specific example two publications. Publication A has a circulation of 2,000,000 and a rate of $8 per line. Publication B has a circulation of 2,000,000 and a rate of $5 per line. If those rates are fair, there must be a big difference in the quality of the circulations — in the altitudes of the rectangles which represent the advertising values. What the advertiser wants is some standard of measurement besides guesswork.

He will find it, I believe, in the cost of production of the publications in question — not, be it noted, the cost of either publication to its individual publisher, but the cost which must be met by any other publisher who would duplicate the publication. This qualification is necessary because an individual publisher might own a print shop and use the publication to take up slack

in his press room, or in other ways might get out the paper cheaper than another could.

The influence a publication has with its readers — which is quality of circulation in other terms — is in the long run relatively proportionate to the cost of production of the publication. If an advertiser could get hold of a publisher's annual balance-sheet he ought to be able to judge of the quality of the circulation of the publication to a T.

Now right here is a good place to stop and explain that this article does not maintain that the cost of production of a publication is " all there is to " the question of quality, or that the only thing necessary to build up quality circulation is to blow a barrel of money on ink, paper and sensations. What this article does maintain is this: That there is a close relationship between the cost of production and quality of circulation, because, primarily, the publisher wouldn't spend the money unless it were necessary in order to get the quality. If he is spending it to get mere quantity, by giving big premiums, etc., or if he is spending too much to get business, those facts will appear from a study of the publication as outlined hereafter. The publisher must take the cost of production into consideration when he is fixing his rates, if he wants to be sure of being in business another year, and the advertiser should take it into consideration because it is an index to the publisher's efforts to make the right kind of a paper. The cost of production is the cornerstone of an equitable advertising rate and the most trustworthy guide an advertiser can have to the quality of circulation, which means, of course, that the cost of production is a trustworthy index to the fairness of an advertising rate.

The old idea used to be (some advertisers cling to it even now) that advertising rates were based upon quantity of circulation only. If that were true there ought to be a standard rate for the standard unit of measurement. In other words, if the number of copies circulated is an equitable measure of the value of a publication, publications circulating the same number of copies should demand the same rate, and all rates should be reducible to one fixed standard of so much per line per thousand copies.

As a matter of fact we don't find anything like a "standard rate."

The *World's Work* gets four-fifths of a cent per line per thousand; the *Saturday Evening Post* gets two-fifths of a cent; *Harper's Magazine* gets between a cent and a quarter and a cent and a third; *Woman's World* gets two-fifths of a cent; *Vogue* gets a cent and a third; *The Argosy* gets two-fifths of a cent; and so on. Among daily newspapers, the *New York Journal* gets about one-fourteenth of a cent; the *Boston Transcript* gets half a cent; the *Chicago Tribune* gets one-sixth; the *San Francisco Chronicle* gets a quarter of a cent.

So it is evident that there is no standard, immutable rate per line per thousand to which all publications must conform. Neither is it true that the publisher fixes an arbitrary value upon the quality of his circulation per thousand (say, a value of half a cent a line) and proceeds to charge at that rate for every thousand new subscribers he secures. Quite the contrary. As the circulation increases we usually find the rate per line per thousand coming gradually down. Advertising rates do not increase in anything like the same proportion that circulations do.

Here is a list presented at random, including magazines, newspapers, class and trade journals, showing the relative rates of increase of advertising rates and circulations covering a period of ten years, taken from the publishers' own statements:

Name of paper	Circulation increased	Adv. rate increased
	%	%
The Automobile	500	100
Topeka, Kan., Capital	306	66⅔
Lippincott's	25	None
Farm Press	564	500
Sunset	200	100
Christian Herald (6 years)	51	26
Interstate Grocer	275	75
Arkansas Homestead	300	40
American Exporter	120	33
Cleveland Plain Dealer (6 years)	64	30

It is quite true that the ratios between the increase of circulations and the increase of rates are not constant. That is because

there is so much variation in the increases of mechanical costs, editorial costs, etc., as between one publication and another. For example, one paper, the Portland, Me., *Express*, reports an increase of 75 per cent in the advertising rates and an increase of but 60 per cent in circulation. But upon further examination we find that the paper's art department costs 186 per cent more than ten years ago, its editorial costs have increased 216 per cent, mechanical costs 143 per cent, rent 198 per cent, and business department 305 per cent. Yet if the advertising rates were based on the circulation a 60 per cent raise would be the utmost limit.

This is exactly where the cost of production comes in. The publisher must add enough to his advertising rates to cover any increased expenditure which he makes for the purpose of increasing the quality of his circulation, and the advertiser who wants that quality must be willing to pay for it. If the advertiser is to consider himself well posted he cannot ignore the subject of cost of production.

Every advertising solicitor knows how hard it is to "put over" a raise in the rates. The advertiser who has contentedly paid forty cents a line for months kicks like a brindled heifer if asked to pay forty-five, even when it is easy to demonstrate that he is getting a 50 per cent increase in circulation. The solicitor can sit down and figure it out on a piece of paper, showing that the rate is actually lower per thousand than when the advertiser began to pay the forty cent rate, yet the latter will insist that forty-five cents is too much. And the solicitor has to work hard to save the business, simply because he hasn't any way — except talk— of proving that the space is worth the new rate.

George Von Utassy, of *Cosmopolitan*, says: "If the magazine pays him it is a good investment; if it doesn't it is not." That is true without question for an advertiser who can trace results. But such advertisers are in the minority. By actual count it was determined that 60 per cent of the advertisers in standard magazines — advertisers like the American Telephone and Telegraph Company, for example — could not possibly trace any results from the individual publication. Unquestionably these advertisers are satisfied with the results, but they cannot trace them.

Moreover, the advertiser who is only considering the use of a publication wants some definite indication as to whether it would be likely to pay him or not. Likewise the advertiser who is asked to pay a higher rate wants the assurance that the quality of the circulation makes it worth the extra money. As a rule, he doesn't doubt the quantity.

The H. K. McCann Company, New York, has made a good start towards a system of gauging the value of farm paper space by something more scientific than guesswork, hearsay or solicitors' arguments. Opposite the names of the various papers are set down the subscription prices; the quality of print paper (good, fair or poor); the number of illustrations in an average issue; the number of people on the editorial staff; the relative number of pages which appeal to women; whether or not there is a strong personality back of the papers; and a column for entering an A, B, C, or D classification according to the information contained in the other columns. It is a good start, but it is not complete. It does not provide for all the factors which may go to make a given medium worth the line rate. For example, a paper which has done a great deal of work educating dealers to the advantages of handling advertised goods would get no credit for it, and a paper with an editorial staff of two might buy enough outside contributions from specialists to make it worth far more than the paper with a staff of half a dozen tyros. Moreover, the subscription price may be $3 a year, but if the farmer gets the paper handed to him as a premium with a patent corn sheller bought at the last county fair he cannot be rated as a three-dollar subscriber.

I believe that a chart can be worked out, with the cost of production of the publication (as nearly as the advertiser can get at it of course) as a basis, which will give an approximately accurate indication as to whether the rate demanded is just or excessive or too low. It may seem as if "too low" a rate were a joke, but it isn't, either for the advertiser or the publisher. Too low a rate means one of two things: failure and discontinuance of the publication, or a cutting of the cost in some department which will pull the quality of the circulation down to meet the rate.

Advertising space is a manufactured article, and too low a price has an effect upon it quite as truly as if it were dress goods or steel rails.

Now the factors in the cost of production of advertising space — newspaper as well as magazine space — which directly affect the quality of circulation are the manufacturing costs (including the quality of print paper, ink, engravings, etc.), editorial costs (including the salaries of staff men, the cost of contributed articles, regular departments and features, telegraph, telephone and Associated Press service), art department costs (including staff artists, photographers, free lance artists under contract, etc.), and a general "overhead" cost (which embraces the personality back of the publication, and the expenses of management and direction of policy). The factors which influence quality indirectly are the costs of the circulation department (the relation between the income from subscriptions and the money spent to get them) and the cost of extra services, such as dealer coöperation campaigns and the like conducted for the purpose of directing the consumer to a place where the goods are on sale. All the various systematic attempts to promote the sale of advertised goods in distinction from unadvertised goods belong in the last classification.

It may seem strange to talk of the cost as a measure of editorial strength or personality, but it is the only term I could find which would come anywhere near indicating what I want to express — the effort the publisher is putting forth to get and hold circulation of a particular grade. Furthermore, it is a term which can be used reciprocally; by the advertiser to judge quality and by the publisher to demonstrate quality. For example, the publisher who can show that the cost of getting subscribers is substantially less than the income received from subscriptions — in other words a high net price for subscriptions — can thereby demonstrate a high percentage of renewals, while a low net price for subscriptions indicates an effort to drag them in "anyhow." Publishers themselves are beginning to appreciate this fact and to use it. A. D. Porter, publisher of *The Housewife*, says in a recent booklet on circulation: "The publisher who accepts a very low net price

for subscriptions universally gets a very low percentage of renewals at the end of the year, whereas the publisher who gets a high net price in his subscription endeavors almost universally obtains a correspondingly high percentage of renewals."

The table herewith is prepared by way of graphic illustration of the kind of analysis I believe can be worked out. "A," "B" and "C" are three publications which regularly carry the advertising of household goods, clothes and foods. The figures in the columns above are grades which represent variations above and below the average quality for publications in the same class. I have arbitrarily chosen "50" to represent that average quality in each of the divisions. By "average quality" I mean that quality of paper, illustrations and the rest which represents ordinary practice. In other words, average quality is based upon a manufacturing cost which cannot be lowered without cheapening the medium unless the average is pulled up by added cost somewhere else.

Name	Print Paper	Illustration	Art Work	Edit. Policy	Contributions	Features	Depts.	Personality	% Net Price	Extra Service	Av'g	Rate per M
A........	50	75	50	80	70	80	..	85	33	95	67	1/2c
B........	50	50	50	20	80	..	..	50	60	..	51	3/7c
C........	30	25	15	15	40	..	75	40	5	..	31	2/5c

For example, the ordinary print paper for standard magazines costs three and a half cents a pound. That may be regarded as standard, and represented by 50. Publications A and B are thus graded. Publication C is printed on a cheaper grade, and can be rated only at 30.

When we come to illustrations, publisher A spends a good deal extra for timely illustrations; runs more illustrations than are absolutely necessary; uses every new invention in the way of reproduction, etc. Publisher B is quite up to normal in that respect, while publisher C gets along with as few cuts as possible.

The column headed "Art Work" refers to the quality of work which goes into cover designs and illustration of articles, etc. A publisher who pays for the work of artists of the first rank

increases the quality of his circulation, and should be credited with it. Since the personal taste of the advertiser is no fair test of artistic appeal, the cost of manufacture is the only safe guide. If the publisher is paying too much for art work the chart will show it before we get through. Publishers A and B are up to the average. C, as is to be expected from the preceding columns, lags a long way behind.

By "Editorial Policy" I mean the purpose or lack of purpose of the publication. Does it stand for anything in particular, or does it swing with every ebb of public fancy? Does it "speak out in meeting," or does it carefully avoid the expression of any opinion on less than both sides of a question? Cost of production is the basis here, too, for editors with a real purpose and the ability to carry it out costs money. Melville W. Stone, general manager of the Associated Press, said at the Pulitzer hearing that he understood that W. R. Hearst paid Arthur Brisbane $72,000 a year. Yet $5,000 would hire a man who could fill just as much space as Brisbane does and not hurt anybody's feelings.

It is obvious that no publication can get contributors of high quality without paying for them, and the disposition to go after contributions of authoritative character is the basis for the ratings in this column. "Contributions" are not to be confused with "Features" or "Departments," however.

A "Feature," according to this chart, is a series of discussions on the same subject or allied subjects of popular interest, like Mark Sullivan's pages on Congressional affairs in *Collier's*, or the "Who's Who and Why" of the *Saturday Evening Post.* A "Department" is the familiar question-and-answer bureau, in which information is the prime requisite and which neither owes its influence to the peculiar literary personality of the writer nor champions any reform, political, hygienic or moral. The moment a department begins to preach or develop a literary flavor it becomes a feature.

Now the reason features and departments must not be lumped with contributions is because all publications do not have them. Undoubtedly Samuel G. Blythe adds to the value of the *Post* as an advertising medium, and "Who's Who and Why" should

justly raise the *Post's* average; but it should not be allowed to pull down the average of *Leslie's*, for example. Suppose a publication has one very strong feature, and a great lot of very cheap contributions, while another publication has a first-class list of contributors and no features at all. It is entirely fair to allow the strong feature to pull the average of the first publication up, but it should not be allowed to pull that of the second publication down. For it has nothing whatever to do with the second publication. Therefore I have listed features and departments separately, and only where they exist is any entry made in their columns.

"Personality" is a difficult thing to define, yet it must not be left out of the list. It is what Mr. Stone referred to when he said that the value of Mr. Pulitzer's services to the *New York World* would be undervalued at $100,000 a year. It manifests itself in the sort of activities Mr. Hearst engages in wholly apart from the actual conduct of a newspaper or a magazine. When the *Outlook* engages Theodore Roosevelt it gets something the value of which is not to be measured by the amount of space he fills nor what he says in it. If you were to buy the *Louisville Courier-Journal* you would want to deduct handsomely from the gross business to account for the loss to the paper of Henry Watterson. Personality is that quality in some person known to be connected with a publication which causes the public to have more confidence in that publication. Mr. Pulitzer bought a decrepit newspaper from Jay Gould and made it one of the best paying propositions in New York largely through personality — by making the people understand that he was fighting their battles.

It happens to be possible to express the entries in the next column by percentages. The Post Office requires the receipt of at least 50 per cent of the subscription price from each subscriber, and fifty happens to be the number of points adopted to signify the ordinary average. So the percentage of the net subscription price received by the publisher is a proper entry.

The heading "Extra Service" covers factors in the building of readers' confidence which are not included under any other heading. For example, *Good Housekeeping's* dealer campaign and

guaranteed goods departments would come under this head, as also *Collier's* dealer circulars and advertising of the Westfield laboratory tests. The Curtis Publishing Company's investigations among dealers would belong here, as also the dealer literature issued by the Orange-Judd Company. But, as is the case with features and departments, the lack of any such activity on the part of a publisher should not be allowed to pull his average down. It naturally raises the quality of *Good Housekeeping's* circulation because it has adopted certain additional services to advertisers, but it does not lower the quality of the circulation of *The Century* because the latter does not do so.

Hence, in computing the averages of each of the three publications, we divide by the number of columns in which entries are actually made: in the case of Publication A, by 9; in the case of Publication B, by 7, and for Publication C, by 8. In the last column we set the rates per line per thousand, and are able to compare them in relation to the quality "Averages" we have worked out. We find that if Publication A is a good buy at half a cent, Publication B is not quite so good at 3/7 of a cent, and Publication C is low value at 2/5 of a cent.

The above is a very brief outline of the system. Of course, it goes without saying that different charts must be prepared for standard magazines, newspapers, class and trade papers.

XXI. Record of Advertising Results [1]

By Thomas P. Comeford

Advertising as a modern method of promoting business is recognized and employed by the progressive merchant of today in every commercial line. Yet when it is appreciated that in all advertising, no matter how well prepared or managed, there is always that element of uncertainty of results, and that hundreds of merchants of today are advertising extensively on the plan that advertising ends with the preparation of copy, getting it into print and paying the monthly bills without question, when pre-

[1] *System*, July, 1909, pp. 92–94. Reprinted by permission of *System*. Illustrations of forms are omitted.

sented — it is little wonder that many merchants cannot understand where the money goes.

I doubt if one could find a successful merchant sending a salesman out to sell his goods with an unlimited expense account, yet he freely invests money in advertising and never goes to the root of the question — why it did or did not pay. Beyond a doubt, he knows the salesman in his employ who is selling the most goods; is it not just as important that he should know what his salesman on paper is doing in the way of results?

He should know the amount of space used each day in each paper, its costs and results. He should know what papers reach the class of people he caters to and the style of advertising that best appeals to that class. He should know what the advertising of each department is costing in proportion to the sales, what percentage of gross sales, competition, local conditions and so on, warrant in advertising. This is particularly important in a department store, as many departments demand more advertising than others.

In order to have such information at hand, a system of some kind is necessary. From my personal experience, I believe a card system fully answering this purpose is one I originally devised for a department store yet is applicable to any sized store with one or one hundred departments. Three different cards 5 x 8 inches in size are used in keeping the records essential to the business.

First is kept a record of each paper or medium contracted with for advertising. This shows the date the contract is made, date of expiration, amount of contract, rate and conditions. One card will answer the purpose of an average-sized department store for one year. Yet this card need not be confined to a newspaper. Various advertising, such as "Billboards" and "Programs," may be listed here.

To keep a record of the advertising used in each paper each month, another card is used. The day's advertising is accurately measured and entered daily. On this card is designated, by a letter assigned to each department, the various departments advertised on each day.

Upon receipt of a bill from the paper, each day's advertising, the total amount and the cost for the month, is easily checked up. At the bottom of the second form, we carry from month to month the amount of space to be used before the contract expires: as in May we used 1,000 lines, hence we had a balance of 9,000 to be used before February 1, 1908, the date the contract expires.

A separate record for each department advertised is also kept. For instance, the dress goods department, known as Department A, was advertised on a certain date. Thus the space devoted to dress goods is measured and charged to dress goods. When advertisements are of similar size, it is not necessary to measure in detail those in each paper. The advertising of each department is recorded. In case it is desired to key each advertisement for space used, a record is kept of that.

The space occupied by the name plate of the firm, by general store news and so on, is not measured in each day's advertisements, nor is an individual record necessary to take care of this matter. It must necessarily equal the difference between the cost of the total departments advertising and the total expense. Hence, when inventory is taken this amount is easily ascertained.

I find this the best method for handling the records, for if fifteen to forty departments are advertised at one time, it is difficult to measure each department's space accurately enough to have the sum balance with the over-all measurement; the difference is regulated in this way, with considerable time saved, and the result is the same.

On the third card is also recorded the actual cost of each advertisement, the amount of sales, the percentage of sales and the exact amount that all advertising for that department is costing. One copy of each advertisement is pasted in a large scrap book and dated. It is not necessary to keep a file of each paper, for if the amount on the card varies from the newspapers' record, back numbers are obtainable (or the files in the newspaper office can be consulted if necessary).

A record of cuts held or returned by the papers may be kept on a paper slip pasted near that cut in the scrap book. As cuts are returned, they are carefully checked off.

In houses having an advertising department a detailed report of the total expenses is given the bookkeeping department monthly, or annually, as desired, yet all records, details, checking of bills and so on should be left to the advertising department for proper handling.

I believe this a most practical, simple and effective system. A small filing cabinet will hold 1,200 cards, enough for six years' work in a large department store, and all desired information concerning the advertising is accessible at any time.

XXII. Testing Copy and Mediums [1]

In a New York mail order house a certain letter asking for a renewal of business is a joke among the advertising men. Written by a minor clerk years ago when the house was young, the letter lacks form. It is crude — almost clumsy. The head of the firm has ordered it destroyed a score of times and his experts have substituted letters which the office agrees are far better than "old go-and-get-'em." But when tests are made the ridiculed letter gets the business and leaves up-to-date copy far in the rear.

So with advertising copy. "If it goes, it goes." The criticism of experts is a good thing; but results and not theories are demanded. The average shows. The public is the court of last resort in judging an advertisement. The court will not be influenced and will not be flattered. But unlike other incorruptible courts, it will indicate to the clever pleader its future decision.

Straws show the way the wind blows and tests tell how copy will go. The shrewd advertiser of today, before beginning a campaign, makes three important tests: He has the public pass judgment (1) on his copy, (2) on the mediums in which the copy is placed and (3) on the field in which the mediums circulate. After copy is approved, it ought to be put out on trial. It should be keyed and the results carefully checked.

A method effectively used by some big advertisers is to try copy for a general campaign in a metropolitan daily, a small town news-

[1] *How to Write Advertisements that Sell*, pp. 111–128. Reprinted by permission of A. W. Shaw Company. Illustrations of forms are omitted.

paper, a farm, trade or class publication, various standard magazines and a woman's journal. The copy is exchanged from publication to publication and perhaps inserted several times in the same magazine. By keeping count of replies and sales it is easy to find which advertisement is consistently strongest. Some firms and agencies have kept records of this sort for years. They know accurately before they start a campaign what pieces of copy " take " and what mediums bring the best returns on their offer. The advertising manager also has before him at the beginning of each test certain theoretical figures which indicate the number of returns he should receive from mediums and circularizing schemes with which he has had long experience. If his best copy in his best mediums falls below this theoretical standard he knows that he must locate " copy trouble " before the campaign may be staged.

How to Make Tests for the Pieces of Copy that Will Pull Best

Testing copy marks the line between the gambler and the investor in advertising. Testing with sufficient ingenuity settles all office doubts about the worth and method of any scheme of publicity. Not only is the test conclusive as to the pulling power of alternative pieces of copy; but it frequently shows the advertiser the amount of space to use to get the best percentage of returns. In Cincinnati a test showed a manufacturer that a certain single column advertisement secured him results as good as his page copy in the same mediums. The difference in cost turned a losing venture into a paying one.

Trial heats will in the average show the winner of the race. After tests are made and checked, the advertisement which brings the most business is strengthened by inserting the selling points developed by less successful copy and the follow-up correspondence. The advertiser is now ready for perhaps a final test and then the campaign.

There are advertising managers who would " fire " a man for running one piece of copy twice, and there are two-inch advertisements that have run unchanged for ten years, building fortunes of seven figures.

The copy test is hardly less valuable in one case than in the other — indeed it alone can decide whether old or new copy is best. It assists no less in perfecting circular letters, booklets and dodgers than in planning a "repeat" advertisement for $5-a-line space.

After many tests on an annual campaign, an implement man in a county seat town in Kansas perfected a seasonable circular letter that brought business beyond his fondest hopes.

"Must I go through this thing again next season to avoid repeating the same letter to my old customers?" protested the vehicle man. "Must I again lose time during my business harvest? Where is this test idea going to end?"

He took down his circular-letter file and compared the various test pieces of copy. Soon he felt that in two clever paragraphs lay the magic appeal. A single test proved this true.

Year after year these two paragraphs of strong appeal masquerade before the farmers of that county under the make-up of a brand new personal letter. And newly worded, the tested appeal has never grown stale or failed to get the business.

Having built publicly approved copy, the general or local advertiser must still determine what territory, classes of mediums and what individual periodicals or other distribution he will adopt. The experienced advertiser has a list of publications with low rates but limited circulations which pull in constant ratios to the national mediums. Advertisements are placed in these mediums during the copy test and the results are checked for territory and classes of circulation as well as for copy.

Testing an advertisement presupposes a way to identify the returns. Here is the crux of the difficulty in thousands of advertising departments. Some of the biggest advertisers in the world are "going it blind" on the strength of good luck. Thousands of smaller advertisers are following their example. These men have been unable to contrive ways to key their advertising for test; but in most lines ingenuity and analytical ability will go far toward devising helpful tests.

Standard and Novel Ways of Keying Your Various Pieces of Advertising Copy

A great Chicago department store frequently tests its advertising methods by moving to an obscure corner of the room the cloak or gown which has been given publicity. The casual shopper passes it by. The customer who has been attracted by the advertising asks where the article is to be found. Count is kept of inquiries.

In preparing to market a line by a new national campaign to dealers and consumers, one manufacturer got records for months back, from dealers in typical cities where the article had been sold. He then tested the new copy in the local newspapers and two especially strong national mediums well represented in these cities. The dealers coöperated by recording sales. The net increase in business, when compared with the advertising expenditures, showed such possibilities that the manufacturer went into the campaign with confidence.

Anything which unlocks the results of advertising is a key to the campaign. The ordinary methods are the coupon — of various styles and shapes — identifying the medium by the type, also by the paper; and the varying departments, street numbers or names and initials included in the addresses. The correct address should never be used, as it is constantly bringing mail not due to any advertisement.

If this keying is crudely done, the reader is annoyed over having his scalp hung at an inquisitive advertising man's belt. The cleverest key is one which develops unavoidably when the purchaser asks for the goods.

Advertising to do a certain thing at a certain time, such as holding an "hour sale," has been found an effective key for the local merchant's advertisement. A watch company keeps track of its advertisements by naming certain of its watches. In one town a certain piece of goods is called a business man's watch; in another it is a railroad man's watch; in another it is a farmer's watch. The local stores handling the goods are an effective key for the local merchant's advertisement. A shoe manufacturing house,

which sells direct to the consumer, in one publication calls its free pamphlet *How to Make Your Feet Glad;* in another, the same book is named *Happy Feet.* A clothing manufacturer uses a style number for his key. In style 345, the 34 indicates the style and the 5 is the key to the advertisement.

World-wide dealers in fountain pens and in toilet preparations distributed through retailers, acknowledge inability to trace actual sales; but successfully "meter" the strength of copy, mediums and trade territories by local demand as reported by dealers and field men, and by the proportionate number of requests received for various advertised booklets, sample packages and the like.

Where the product represents a large expenditure, as in the automobile field, sales should be checked back to the decisive copy, mediums and follow-up. Even in the case of smaller articles keen advertisers often go to great lengths in correspondence and personal field work to know exactly where business originates and how the advertising checks out. Although an absolute check may not be made, these long-time records of comparative efficiency are very valuable.

Making the Campaign Measure Up to Test

That advertising test is most instructive which has most closely followed every condition you will meet in your actual campaign.

A mail order house which sells Panama hats became converted to the idea of testing advertisements. Copy having been tried in various mediums with success, a national campaign was inaugurated but with discouraging results.

The hatters were ready to resume their hit-or-miss style of publicity when an advertising "doctor" pointed out their recent error. The tests had been conducted in the spring and early summer when the demand for straw hats was keen. The campaign had been run into midsummer, when most men had secured the article advertised. Apparently the season was too limited to permit both test and campaign in one year.

The following year the tests were begun early. Orders and inquiries were few but indicated the relative strength of various

copy, sections and mediums. When the campaign was launched in the spring and early summer, the magazines which had earlier done the best work continued their lead — and the shop worked overtime.

In the long run, tests on both inquiries and orders are sure to develop helpful ratios to the actual campaign in similar territory and with similar or identical copy and mediums. Single tests or records covering short periods, however, must be considered in the light of varying conditions.

How to Guard Against Features that May Make an Advertising Test Deceptive

Certain newspapers will produce mail order results on days of light store advertising far out of proportion to other days in the week. Position of copy, whether well printed, the amount of space, the strength of competing advertisements, must all be considered. In some businesses a record of advertising for several years proves that the proposition " pulls " best in most mediums when first advertised, and that " the cost per order advances as the advertising is continued before that same body of readers, regardless of whether the copy is changed or not." Continued returns on some one-time propositions keep up best in mediums which change the mass of their readers from season to season.

The local merchant must investigate neighborhood conditions and can determine by test the best time for his advertisement to appear. The druggist who distributes his advertising at the curb side in the waiting buggies of his farmer prospects may not get attention until the Saturday night drive home; while the clever merchant, who reaches his farmers Friday with announcements of his Saturday or " First Monday " sale, has acted at the right time. Rainy seasons make the farmer read. Local seasons, celebrations and calamities make differences between test and campaign. Every condition which affects interest or buying power marks on the record of your advertisement. A sure way to avoid disappointment is to test under less favorable conditions, and, having found a plan which will balance the cost or clear a profit here, to make the most of it at once.

The personal temptation to vary conditions between test and campaign must be curbed. An enthusiastic Northwestern jobber secured a list of ten thousand names. The advertising man urged a test on five hundred or a thousand names, but the jobber, in his enthusiasm over the cleverness of the copy, ordered the entire campaign out under two cent postage.

Within fifteen days, more than one-eighth of the letters had come back unclaimed. The list was stale. Moreover, a serious mistake had been made in the booklet which went with the letter. A test would have eliminated both these losses.

In another case the same jobber carefully tested out fifteen hundred high-grade names on fine stationery under two cent postage, only to mail the main campaign under the green stamp at a loss. Comparative tests under one and two cent postage would have told the story. Dissimilar conditions only made the test misleading.

An Eastern manufacturer recently launched a seasonable dealer campaign after making workmanlike tests of seven different styles of copy. One set of commercial literature had scored profitable returns ($3\frac{3}{8}$ per cent) on a very difficult sale. At once the full campaign was put out carrying these pieces of copy; but delay in making up the returns on the tests had brought the season almost to an end before the full supply of literature came from the press, and the campaign proved a failure.

Accuracy and dispatch are the essentials of campaigning by test.

Keeping Reference Records and Specimen Advertisements

Center in one responsible and efficient person the full responsibility for accurate records and files of your advertising, its cost and its returns.

An adroit business man, who has built his success upon advertising, charges a worse error against his auditor for losing a single count in an advertising test, than he might for dropping a significant cipher in the ledger. This man has found that in his business a skillful test will average within from 8 to 15 per cent of campaign profits. Failure to count an order, or a few unidentified

inquiries, might lead him to discard winning copy—the seed from which sales spring.

One of the chief assets of this advertiser is his record of past results. The man who believes that he can keep such results in his head, or who glances through the mail, "estimates" the strength of various tests and selects mediums by opinion, is deliberately draining profits into loss.

Often an advertising man must assert himself in the most decided way to establish and maintain a genuine testing and record system in the office routine. A division advertising manager who had worked out tested copy and follow-up literature was called to the New York office recently to account for lagging business. The charge was that his copy was bad. He drew from his pocket a record card and proved that in three separate tests the copy had proved itself high-grade. "How about returns now?" was the general manager's question. "That I cannot say without getting up-to-date records from the corresponding department," said the advertising man; "but I have seen a large number of coupons and miscellaneous inquiries in the mail from day to day."

The advertising manager returned to the branch office, went into the follow-up division and found that an average of forty inquiries per day on a $22.50 proposition were being allowed to grow stale for perfunctory follow-up at three weeks intervals, through the carelessness of subordinates and poor stock keeping on the follow-up literature. The desk drawers in the department were crammed with uncared for work of this sort because no proper head kept tight rein and demanded records every day.

In another instance an advertising manager was working to convince an employer prejudiced against his publicity. Orders and inquiries came in well but envelopes bearing the street or department "keys" were often thrown into the waste basket by a careless letter opener and by stenographers to whom the correspondence had been given before it was properly checked up. The advertising man was perpetually running a race with the colored porter to keep the keyed envelopes from the flames. Checking returns at the cashier's desk would have eliminated this element of doubt from the business.

While these are extreme examples, it is nevertheless true that the machinery of tests, records and follow-up is the most valuable and the most abused machinery in many businesses; and that it merits no less care than the actual disbursement of funds.

The willingness to keep records often is hampered by lack of system. One Chicago man, finding that the ordinary scrap books were not large enough for his purpose, secured the largest size loose-leaf invoice books. The advertisements were pasted on manila sheets and kept until out of date. Then they were removed from the covers, tied up and stored in a confidential file in the vault. To each advertisement is attached a printed slip showing the total sales and inquiries traced to the copy, the medium in which it appeared and the number of times it ran. Another sheet shows in detail the cost of the advertisement proportioned among the various departments of the store.

This plan of filing returns on advertisements with the copy is cumbersome. One system which has worked out with much success is the result of development during the past four years. The advertiser has written and placed advertisements of all sizes on a dozen different propositions and also circular letters and commercial literature on various offers. Every advertisement carries at the bottom a number in five point type. Every piece of commercial literature also carries a number; and every circular letter has at the bottom, following the stenographer's initials, a similar key. This not merely identifies every proposition, but affords a basis for filing, noting results upon and re-ordering or following through every piece of copy which the department handles. Periodical copy is numbered from one up, in five different groups, identified by the letters A, B, C, D, E, as A25, B26. The letter indicates the proposition the copy covers. Specimens are filed numerically in folders, one for each class letter. Three copies of each advertisement are usually put in so that there are extra copies at need. They are not pasted. Folder contents are transferred from the vertical desk file to the vault every year, so that the folders are never cumbersome.

Circular letters and commercial literature on different propositions are filed in the same way under subsequent letters of the

alphabet. The letter and number at the top of any record card identifies the advertisement and indicates at a glance what kind it is and on what class of goods. In ordering a new run of a standard circular letter, or applying to the stock room for a supply, all that is necessary is to give the letter and key number of the circular wanted. This system also facilitates stock keeping and the perpetual inventory which enables the advertising man to use up circulars while they possess selling value.

The cut, drawing and photograph cabinets are arranged in the same way by letter and key number, showing the relation of every cut to the advertising campaign and specimen file.

How to Plan Your Next Campaign by Past Averages

Advertising records properly kept are the military maps of the country fought over last year and again to be the scene of the campaign. They may be used in scores of ways; they indicate the relative value of first and third class postage, of personal and circular letters, of printed matter of different kinds, with illustrations of various sizes and positions, of sales schemes, coupons, and every selling device put to test. They show the best seasons, and in one instance prompted enlarging an ordinary half page into three full pages with proportional profit each spring and fall.

What Records of Advertising Tests and Campaigns Can be Made to Show

Nearly half a million dollars was spent last spring by a mail order concern for colored inserts in its catalogues. This expenditure is based chiefly on one season's experience with colored illustrations. During that season colored illustrations in connection with revised and strengthened copy showed a good increase in business over the previous year.

Perhaps it was the colors that brought business — perhaps the new copy; perhaps other and unconsidered factors. It would have been easy to test out in adjacent counties two circulars identical except for the use of colors, but no test seems to have been made. Another mail order concern does not use colored

illustrations to nearly so great an extent, considering it better, wherever possible, to rely on inquiries for actual samples that will show texture.

Opinions — but no tests. Progress for both — through good luck and the great virgin field of American purchasers.

Advertising success cannot be developed in this way. Every general advertiser and every local merchant owe it to the business to set aside sufficient money to keep a record of advertising experiments and experiences.

Having kept a file of advertising specimens and a record of costs, inquiries, follow-up costs, orders and profits, and so keyed the advertising as to distinguish the different pieces of copy and different mediums as completely as clerical expense makes advisable, the advertiser can turn to his records and map out the next campaign with almost the same certainty that he plans for a new building or employs and trains help. Of the many vital business facts so developed, the following are only a few:

"On my proposition logical copy with well authenticated testimonials sells to men; but a woman wants the name of some one in her town to whom she can go for personal testimony."

"Only seventeen mediums out of a list of thirty-seven magazines and newspapers proved profitable for me. Newspaper inquiries come cheaper but seem to include more curiosity seekers, as the cost of orders runs higher."

This advertiser went to great lengths to trace down every inquiry and order to its proper advertisement and medium, even where this meant hours of work and letter writing to credit an advertisement that had appeared years before. Now, however, he knows to a penny just what inquiries and orders to date have cost him in every medium; and not only what pieces of copy to repeat, but what circular letters he can send each new prospect, in what mediums he shall re-order space, what mediums he must cancel entirely and what mediums may possibly pay him after holding out his advertisement several months until tardy returns catch up with space cost.

This advertiser insists that his first advertisements pay best and that thereafter he sells at gradually increasing cost. So

records will show the relative value, to your business, of newspapers, news-stand circulation, magazines that renew constantly and magazines that constantly reach new readers.

As the new campaign is to be opened, therefore, study and tabulate the results of past campaigns in a way to develop the efficiency of different appeals, different pieces of copy, different styles of illustration, different sizes, different shapes and positions, blind versus signed advertising and any publicity question that puzzles you.

The success of one advertising agency is admittedly based on the amount of evidence accumulated as to copy, seasons, prospects, fields and publications. This agency can closely forecast what reception will be accorded an advertising campaign. The proportions between mediums used for testing and mediums used in making the final appeal have been so carefully worked out that results are not a matter of conjecture, but may almost be written ahead.

Store advertising cannot so easily be put on a ledger basis, but last year's advertising specimens and records will suggest to the storekeeper what to buy this year, what will be the most popular as well as how best to describe and illustrate it, what mediums and sales schemes are most valuable and what sections will produce the most trade or need the most effort.

A Southern department store advertiser has a daily sheet on which are tabulated for today, and for the corresponding weekday last year, the sales income and the advertising expense of each store section. This record enables him to develop each department as it shows seasonable chances of profit.

A clothing store has a special ruled form which the advertising manager keeps under the glass top of his desk. This form shows the condition of stock and the amount of business done every day for the past year. There is also room on the form for notes regarding weather or other unusual circumstances. When planning publicity, the advertisement writer looks over his chart. He sees, for instance, that business in the men's furnishings is not up to the standard maintained on the same day of other years. He calls the department manager.

Reference to the manager's detailed charts shows that a certain style of hat is not moving as rapidly as it ought. As a result, copy is concentrated on that line, prices are cut if need be and the department is cleared of its dead wood before the opportunity slips away. In this manner, day by day and year by year the business of each department is steadied and graded upward with a minimum of false steps.

Experience is the final word in advertising. The expert advertising man gets it — gets it on paper — and handles it with open eyes, like a ledger-sheet, on the basis only of what his advertising produces.

XXIII. How Keyed Returns May Throw Light on Mediums and Copy [1]

By Grafton B. Perkins

Mixed with brains, a keying system is about the best assistant any manager of a national or territorial campaign can tie up to. But with the brains left out, the same system becomes a false counselor of the worst kind.

Nine times out of ten, the last analysis shows that keyed returns, intelligently interpreted, afford the most conclusive test of the comparative values of individual pieces of copy or of individual mediums.

There are a few large, highly organized houses whose whole system of distribution is so closely held in hand that results from advertising can be directly traced. But for the majority of advertisers, a complicated distribution, part to jobbers, part to large retailers, makes any test along this line all but hopeless. Jobbing territories overlap, purchasing for one field is done in another and remote one, and the whole process is so interwoven that it is usually impossible to say that because direct sales to Indianapolis are heavy, advertising there is paying well, or that because similar sales to Los Angeles are weak, the ultimate consumer in southern California is not being properly reached by the publicity.

[1] *Printers' Ink*, May 22, 1913, pp. 3–8. Reprinted by permission of *Printers' Ink*.

For example, in a certain campaign the books showed an astounding stimulation of sales in Providence, far beyond anything which could be expected to result from the advertising. But with the same campaign running in Boston, results were unduly slow. Boston being by far the larger jobbing center for that trade, the obvious inference would be that the campaign in Boston was ill-planned. But it developed that one of the biggest Boston retailers did all his buying from a Providence store, while Boston was by far his largest outlet.

Again, the direct sales to a big Ohio city stopped almost simultaneously with the opening of the advertising campaign there. On the surface, the campaign had proven disastrous, but investigation showed that the only jobber who had hitherto bought direct had begun to buy in combination with a jobber in a neighboring city. So the details of an advertising campaign cannot always be studied from the pages of a ledger.

But wherever any number of direct inquiries arise from advertising, or wherever the proposition can be adjusted so as to introduce that factor into the campaign, an excellent guide to the comparative pulling power of copy and mediums is at hand, worthy of the very closest study. The tests thus furnished are not and, except in the cases of purely mail-order advertisements, cannot be conclusive in themselves, but they do furnish the best single clue that the advertising manager can usually obtain.

In my own work I have rarely known the number of inquiries, not traceable to their sources, to exceed 4 or 5 per cent of the total and, even without asking for postage to be enclosed, I have not found that enough of the requests were aroused purely by curiosity to affect seriously the accuracy of the tests.

In fact, with a sample or booklet offer placed at the end of an advertisement, with no special display to draw attention, it seems fair to assume that very few will notice the offer who have not already been interested enough in the proposition to read through the body of the advertisement.

That keyed returns are directly in proportion to the selling power of an advertisement would be hard to prove. Surely it would be equally hard to disprove. Personally, I have always

felt that, between two advertisements in which the sample offer was sensibly the same and equally prominent, the one which produced the greatest number of inquiries was certainly the one which had attracted the more attention and aroused the more interest, and that its greater sales effect could be assumed therefrom.

This refers solely to keying used to differentiate between two pieces of copy inserted in the same list of mediums. Were the test made on insertions in one magazine or only a few newspapers I should place less reliance on them, as too many factors, such as position, appearance on an unfavorable day, etc., might affect the results. But with insertion in a reasonably large list, the law of averages comes into play to permit an accurate comparison.

Also, this does not refer to keying to test the comparative values of two or more different periodicals.

Usually I key every important advertisement and keep a close daily record of returns therefrom. So far as possible, the offers for samples, booklets, etc., in a given series are kept roughly uniform, in order that the tests may be fair in that respect, but otherwise the series may vary very widely as to size, style of display, illustrations, etc.

The cards bearing these daily records become the very heart of my work. As each advertisement appears in its turn, just so surely does its record appear on its card, and so regular is the curve of these responses that by the third or fourth day I can tell approximately what will be the final " score " of the advertisement, and can kill a poor advertisement before it has had time to appear a second time.

As my principal list is at present arranged, the returns will be somewhat in the following ratio, the absolute figures varying with the advertisement:

First day	45	responses
Second day	84	"
Third day	196	"
Fourth day	189	"
Fifth day	106	"

After the fifth day the returns decrease gradually, with a few stragglers daily for a month or two after a single insertion.

By watching this " thermometer," it has often been possible to make each successive series of a given class of advertisements produce increasing returns, regularly, excepting when radically different copy has been from time to time introduced experimentally, when the newcomer, being based upon no previous experience, may be strong or weak. This increase has become so definite a thing that, after six or seven months of watchful development of a type of copy, the exact order in which a new series of a dozen or more advertisements will " score " can be closely foretold.

When an advertisement proves itself a headliner, I naturally repeat it in the next series or a subsequent one. Sometimes (1) the repetition will be absolute, in which little new can be learned; at other times (2) I will change the advertisement in some one important detail, as of arrangement or illustration, having the balance of the advertisement the same.

From the former course, I have become convinced that an advertisement repeated unchanged within two months, in the same list of papers, will never pull as well the second time. This loss is not so great as to forbid my repeating a good puller within that time, rather than run a dark horse, but it is great enough to make me abandon many a moderate success, preferring to take my chances with a new candidate. The difference may be slight, but it is always there. Of three insertions of the same advertisement in one week, the first has pulled only a little less than the other two combined. I do not ask better argument for frequent change of copy, provided that quality of copy remains equal.

When the advertisement is changed in some one essential detail, the most important and conclusive tests are made. An advertisement ran in all type, clear, open and legible. It pulled remarkably well, but, not satisfied, I included it in the next series, identically worded, but set in six-point solid, with its heading greatly reduced, but incorporating a cut that " told a story." The returns increased 50 per cent, although the two advertisements ran in the same list and occupied exactly the same space. And the second advertisement was handicapped by the fact discovered above — that an early repetition of the copy brings less results than the first insertion, other things being equal.

This shows how the results of one test bear on those of another. Had the number of returns in this last case been close, I should have been led astray by them had I not the other test to guide me. The test is also a step in proving the value of illustration.

In a campaign of a few years ago we felt that a very large part of the business arose from advertisements directed along a certain line, and this was accordingly played up heavily. The adoption of free samples made a keying system possible. Within two months we saw that the theorizing of years was entirely at fault; that a certain argument was of minor interest and the space devoted to it was therefore reduced.

Conversely, a single experimental advertisement on a hitherto neglected subject outpulled any other advertisement in the series two to one, and since that time that subject has been given a prominent position in every series.

Similarly, feelers thrown out in the shape of small advertisements — often rate-makers — have many a time shown the public's interest or lack of interest in some new line of approach. If successful, this has found a place in future campaigns.

I am at present awaiting results from an investigation which suggests the details into which it is possible to go. In a recent series I had three advertisements of which, by merest chance, the headings and the texts could be interchanged. Here was an opportunity too good to be missed. I shuffled the headings and texts before putting the advertisements into the next series, and expect, by comparing the two sets of returns, soon to have a good idea whether the comparative strength of the three advertisements depended largely on the headings or on the balance of the copy.

The importance of the finer details of display are equally well tested by this method. Not only can it be quickly shown whether or not illustrations are worth the space they occupy, but the best position for the illustration is as readily determined. Shall the illustration be at the top, with the heading immediately following, the text last? Shall the title come first, then the text, with the cut artistically balancing the whole, at the bottom? Or is some other arrangement preferable? The solution is worth seeking.

In the comparison of various mediums, keying serves in good stead, although the results in this field should be even less mathematically reckoned. More common sense must enter into the proposition. In examining individual papers or magazines, it would seldom be safe to throw one out solely because it did not show up well in keyed returns, any more than to discard for general use a line of copy that failed in a certain paper, whereas one might discard the same copy if it failed in a representative list. The mental type of the readers of a paper must be taken into consideration. One would hardly expect the habitual readers of a three-or-five-cent financial daily, for instance, to write as freely for samples on a 50- or 75-cent proposition as would the readers of a popular one-cent paper, simply because, taken as a class, the former are more well-to-do than the latter, on the average, and more likely to spend a small sum outright rather than to bother about samples.

But by allowing for such fundamental differences, and by using keyed returns as a link rather than as a whole chain, much useful evidence may be deduced.

Not long ago I tested two of what might be called the second string of New York dailies, comparing the returns with those from the first-rank papers of similar class, pro rata, of circulation and cost. The result was a speedy confirmation of my previous impression — that for my particular proposition they were not worth the price asked.

Copy which I have "standardized" by recording its pulling power in representative daily papers of unquestioned value is to me exactly what "standard solutions" are to the analytical chemist — I use them over and over again to gauge the strength of other classes of mediums, always prorating results as to circulation and rate per line. More than once this process has shown the value of classes of papers which had previously been overlooked, and some of which could never have been measured by any test of their direct effect on sales, because of their broadcast circulation.

Equally, such "standardized" advertisements help to point the finger of suspicion at the weaker brothers which have crept into the list.

An advertising man has been spending thousands of dollars in one very large class of mediums, unquestionably going into just the territory where the rest of the campaign was thought weak. By every theory that he or his associates could deduce, the mediums should have been ideal for his proposition. So strongly were they intrenched that he had never keyed his returns from them. One month he did so. Returns were so small that he discovered that each inquiry cost from eight to twenty times as much as from the same advertisements in other tested mediums.

The blind follower of keyed inquiries would have dropped the mediums at once, but this man was not content to do so. Other large advertisers, whose buying of space was usually of the closest, continued to employ their columns freely; and after using the mediums for so long a time, he hesitated to drop them and lose the cumulative effect of his past advertising. But every keyed advertisement told the same story.

Representatives of these mediums insisted that it was because their readers were "somehow" of a different kind, men and women who, for some reason, did not respond as freely as readers of other literature. Examination of original inquiries failed to disclose any marked difference. The writers appeared to be of a slightly higher average type than those who responded from one similar class of mediums, and slightly lower than those who responded from another. The only explanation seemed to be that, while the periodicals in question undoubtedly had wide circulation, they were not vital enough to the individual subscriber to be closely read. His investigations seemed to prove that practically every subscriber also took one or more of the other mediums which he used.

This is typical of the relations of keyed returns to the determination of mediums. A poor showing did not cause this group to be dropped, but it did direct suspicion towards it and demand that it prove its value.

Certainly, mixed with brains, the keyed return is the best and quickest single test for which the general advertiser can hope.

XXIV. Cumulative Value and Advertising Record Keeping [1]

By William A. Shryer

Any successful business, whether an advertised business or not, is the result of growth. It is very difficult to create a successful business, as both trade and profits appear to pile up gradually, with the tendency constantly to increase. In practically every unadvertised business a maximum of increase is attained in a comparatively short time. In an advertised business the limit of profitable extension is usually commensurate with the skill, courage and ability of the advertiser. Some advertised businesses exhibit the maximum of profit quickly, defying all attempts to expand thereafter. Such cases are comparatively rare among those skillfully advertised, although the conditions of certain lines of trade preclude any increase after a certain limit of possible business is reached.

An accompaniment of advertised business is this tendency of cumulative increase. This marked characteristic of most advertised businesses has been turned to immense profit by the publishing interests, who long, long ago pounced on the principle and declared it the essential property of the advertising medium, instead of a principle of the business advertised. This pernicious doctrine, so skillfully fostered by the space seller, has developed for him a superstitious fetichism that is actually venerated as an unshakable law. Conceived in the dim past, the doctrine of cumulative value is kept alive by the seller of advertising through the pure ignorance of the buyer of advertising. In discussing the subject here let it be thoroughly understood that any attack of mine is not against the principle of cumulative value, but against its appropriation by the publisher who claims cumulative value is an attribute of his medium, whereas it is strictly an attribute of honest, satisfactory business methods. Cumulative value is no more the peculiar attribute of an advertised business than it is of an unadvertised business. An advertised business, however,

[1] William A. Shryer, *Analytical Advertising*, pp. 77–96. Reprinted by permission of Business Service Corporation.

has a potential area manifestly greater than any unadvertised business. To secure real cumulative value the advertiser must be infinitely careful, honest and honorable in dealing with purchasers, and through such policies he may expect a degree of cumulative value that is absolutely beyond any possible return of such character for the unadvertised enterprise.

It has never been hard for the seller of advertising to hoodwink the purchaser of advertising. The proper appeal to our imagination will always " get " us, no matter how unlikely the slick argument is, when viewed in the sane light of reason. The psychological explanation of this superstition relative to cumulative value is easy. The sellers of advertising have always said it was the true word. Few if any advertisers ever doubted the statement sufficiently to put it to a true test. As a result those who failed to succeed were content to berate themselves as the "experts" berated them, and the failures were chalked up to " wrong copy," or what is more probable as the experts' opinion, " not enough money spent." There are plenty of other excuses that might be conjectured, but these two are sufficiently prevalent to make a catalogue of the others superfluous.

The favorite platitude of the seller of advertising is " constant dripping wears away the biggest stone." A careful analysis of the meaning behind such a platitude will convince most advertisers that their chances for success through such a process are about as slow and sure, during the course of an ordinary lifetime, as the practical geological result is likely to be manifest in any ten human generations. The cumulative value of publications and the wearing away of geologic formations are equally effective and practical.

The concrete manifestations of this platitude take the following forms as selling points:

Every advertiser is familiar with each of these statements:

1. The first insertion of your advertisement is no practical test of its efficiency.

2. In order to secure any practical test for your advertisement it must appear not less than three times in a publication.

3. By constant repetition of your advertisement in a publication you will at last secure profitable returns for yourself from it.

4. You cannot secure profitable results by spasmodic insertions of an advertisement in any publication. If you do not have the " courage " to run an advertisement constantly and long you will fail.

5. The longer and more persistently you run your advertisements in any publication the more profitable it will become for you.

A self-evident corollary is the necessary result of such superstitions. It is that unless the advertiser has an unlimited amount of money for experimental purposes and an unbounded faith in such representations he will fail, unless some divine providence endows him with a degree of prescience that insures copy of miraculous pulling power.

On entering the advertising field I was aware, in a more or less hazy fashion, that each of the above five " laws " were supposed to have been written by some advertising Moses and to be the more reverenced on account of their Apocryphal character than might be the case were their authority vested in any ordinary human of modern times. With characteristic agnosticism I asked to be shown, but no facts nor figures were adducible. I have yet to learn of any scientific data in support of the prevailing dogma. I quickly commenced gathering data myself, with the uncontrovertible result, the farther I went, that each and every claim in support of this common belief was, in my particular case, absolutely erroneous.

During my extreme infancy as an advertiser I exhibited a degree of bull-headed obstinacy that was the despair of many a magazine special. Their cumulative value theory attracted me mightily, first because it violated every principle of psychology, logic and reason and nevertheless appeared to be the guiding principle of every seller of space I met, as well as the accepted belief of most advertisers. Second, because, if true, it certainly meant a great deal to me as an advertiser and I wanted to be sure of it.

But, I had to be shown, and no one in over four years had been able to do it. I have listened to many spellbinders, and have participated in many wind jammings and have many the time

and oft asked for facts and figures to support the fanciful oratory so plentifully employed in eulogizing old cumulative value. No facts — no figures — just faith. Faith is a great thing, and without it this life would be a desert waste, but in buying advertising of the seller of space I prefer faith in facts and figures to faith in ignorance, especially as faith in the seller's theory is purely at my expense. He rarely if ever tries it, you will notice.

With the firm conviction that the problem was in reality one easy of solution in my particular case I started out to solve it, and did so to my own satisfaction. I exhibited my results to the devotees of the dogma. They were considerably surprised to learn that my records were absolutely open to their inspection, and on account of it were much inclined at first to entertain grave doubts as to my sanity. As time went by and the records of month to month strengthened in convincing material, doubts of my personal sanity seemed to wane, and in its stead the records were dubbed "perfectly extraordinary, don't you know"; "most interesting and remarkable, but absolutely unique, don't you know." Never having had any experience in advertising I began to view my proposition as the one great exception, and for a number of months took pardonable pride in having evolved a business that presented manifestations absolutely contrary to those of any other advertiser since advertising was discovered. As time passed I became directly interested in the exploitation of other propositions through advertising, and from time to time secured more or less complete records of the results of other advertisers. The facts then began to come out. My original observations relative to cumulative value were exactly the same, in all essential particulars, as those that invariably manifested themselves wherever careful dependable records were kept. All of my own records will be given later, as well as a number of others, and they will show that all the prevailing theories of cumulative value are absolutely erroneous, misleading and in many instances are absolutely fanciful.

By means of accurate records, without which few advertisers have any excuse for being, I succeeded in deducing the following laws for my own business:

The first insertion of a tried piece of copy in a new medium will pay better, in every way, than a subsequent insertion of the same copy in the same magazine.

The reappearance of the same piece of copy in the same magazine will pay less in direct proportion to the number of times it runs consecutively.

By inserting a certain piece of copy in a certain magazine and skipping every subsequent issue until the first (or any insertion) pays out it is possible to use certain publications that would mean almost dead loss if used consecutively.

Changing copy and running consecutively will not prove any more profitable than running the same copy consecutively, if each change is equally strong copy.

The first piece of copy in any publication will, per dollar spent, produce more business than any piece of copy ever run in that publication.

The longer any copy is run in any publication the more it costs to run it and the less results it pulls.

All advertising from which these rules were deduced was keyed according to size of space. The spaces used varied from four lines classified to three page readers. Every piece of copy of a certain size, in a certain medium, was keyed the same irrespective of the number of times it showed, or the intervals succeeding insertions. A piece of fifty-six line copy run in 1909 in *Everybody's Magazine*, for instance, was keyed 29. It was repeated often, the latest showing being in July, 1911, and keyed the same. This style of keying gives every benefit to the magazine, as sales are just as likely to result one time as another, as a continuous follow-up is working on every prospect all the time. All inquiries that come in at any one time may be the result of the same advertisement in any one of the preceding issues. This results in giving any single insertion a decidedly favorable handicap, but in spite of this every rule outlined above has proved there is no such thing as cumulative value in any publication. Now and then some isolated cases violate these rules, and more inquiries may be secured on a second insertion than on the first. By subtracting those proportionately attributable to the first, it would almost invariably prove the

second or later insertion poorer than the first. By keying all the same in this fashion, it has also been possible to maintain a fairly even average of interest for several months. Sometimes an intermediate insertion would actually show better than the first or subsequent insertions. Such cases usually proved some particular feature responsible for such differences. Better position, some especially interesting article in some number, or one of any number of possible explanations would be evident. In some cases no explanation would be apparent, but one great rule has never been changed, and it is a death blow to any publication trying to sell me space on cumulative value theory. Every publication either wears out for any single proposition, if used consecutively, or increases in cost to a decidedly marked degree, usually prohibitive.

Varying in no essential particulars, every set of records I have had any opportunity to examine have proved exactly the same things as mine have proved.

Several years ago a popular magazine conducted a subscription campaign which actually embraced the use of magazines as well as newspapers. The subscription price was $1.00. The size of the space varied somewhat in different mediums, but the table of advertising costs will show the approximate sizes. The results of this campaign were given to me with the request that I use them with no mention of the publication's name. The copy pulled subscriptions direct.

The tabulated data of this campaign is given below.

An analysis of these actual results in securing magazine subscriptions develops many interesting features. I will point out several that are particularly illuminating in reference to the cumulative value superstition.

The average cost per subscriber from the entire campaign is $1.10; $3,147.94 in advertising resulted in 2855 subscribers at $1.00 each.

The average cost per subscriber from the first insertion of these advertisements is eighty-five cents. This includes a count of the publications used only once. The total amount spent in one time insertions and in the first insertions of those used more than once was $1,870.19, which resulted in 2196 subscribers.

Date run	Medium	Cost of ad.	No. of subs.	Cost per sub.
March	Technical World	$40.00	51	$0.79
April	Technical World	40.00	20	2.00
February 19	Saturday Evening Post	250.00	338	.72
March 6	Saturday Evening Post	250.00	181	1.38
February 12	Scientific American	37.50	47	.80
February 17	Youth's Companion	200.00	234	.85
March	Circle	30.00	10	3.00
April	Circle	30.00	3	10.00
February 26	Collier's Weekly	100.00	136	.73
February 19	Literary Digest	45.00	58	.74
March 19	Literary Digest	62.50	35	1.80
March	American Boy	50.00	66	.75
February 3	Chicago Journal	12.00	17	.71
March 3	Chicago Journal	27.00	13	2.07
February 6	Chicago Examiner	90.00	258	.35
February 27	Chicago Examiner	90.00	94	.95
March 6	Chicago Examiner	90.00	57	1.60
March 13	Chicago Examiner	90.00	25	3.60
February 5	Chicago American	31.50	24	1.35
February 6	New York American	112.50	131	.85
March 6	New York American	112.50	71	1.38
March	American Magazine	52.50	74	.74
April	Cavalier	20.00	6	3.33
April	Argosy	60.00	29	2.06
April	Railroad's Magazine	30.00	19	1.63
April	All Story	40.00	13	3.07
February 13	Chicago Inter Ocean	15.00	20	.75
March 6	Chicago Inter Ocean	33.75	29	1.16
February 15	New York Journal	49.00	62	.79
March 8	New York Journal	112.50	53	2.12
February 27	San Francisco Examiner	30.00	67	.45
March 20	San Francisco Examiner	42.50	9	4.71
February 27	Los Angeles Times	15.00	2	7.50
February 27	Denver Post	12.00	6	2.00
February 27	New York World	25.00	18	1.40
February 25	Detroit News	15.00	23	.65
February 27	St. Louis Globe-Democrat	30.00	21	1.43
February 27	Minneapolis Journal	11.00	21	.52
March 13	Minneapolis Journal	24.75	2	12.37
March 27	Minneapolis Journal	24.75	1	24.75
February 27	New York Herald	42.00	39	1.08
February 27	Chicago Record-Herald	20.00	23	.88
February 27	Philadelphia Times	12.00	22	.55
March 20	Philadelphia Times	27.00	3	9.00

Date run	Medium	Cost of ad.	No. of subs.	Cost per sub.
February 27	Los Angeles Examiner	$10.00	16	$0.62
March 13	Los Angeles Examiner	22.50	11	2.22
February 27	Chicago Tribune	30.00	72	.41
March 20	Chicago Tribune	67.50	9	7.50
February 27	Boston Post	20.00	32	.63
March 13	Boston Post	45.00	7	6.42
February 23	San Francisco Weekly	20.00	23	.90
February 20	Philadelphia Inquirer	25.00	23	1.09
April	Blue Book Magazine	37.50	16	2.34
April	Popular Magazine	56.25	16	3.51
February 20	St. Louis Post-Despatch	20.00	38	.52
March 13	St. Louis Post-Despatch	35.00	26	1.73
February 20	Cincinnati Enquirer	18.00	24	.75
March 20	Cincinnati Enquirer	40.50	8	5.05
February 19 February 20	Saturday Chronicle-Telegraph Pittsburgh Gazette Times	18.00	19	.95
February 20	Kansas City Star	20.00	14	1.43
February 20	Rocky Mountain News	10.00	6	1.66
March 7	Cleveland Press	14.00	16	.87
April	Hampton's Magazine	58.44	42	1.40
March 23	Christian Herald	36.00	6	6.00

The average cost per subscriber on the subsequent insertions is $1.91. "Cumulative value" raised the cost from eighty-five cents to $1.91.

The "magic third" insertion was tried but twice. In the first case it raised the average cost in that medium from thirty-five cents to $3.60, over ten times the cost. In the second case it raised the average cost from fifty-two cents to $24.75, an increase of over forty-seven times. Old cumulative value was evidently asleep at the switch.

Twenty-one insertions in magazines yielded 1400 subscribers for $1525.69, at an average cost of $1.08.

Forty-four insertions in newspapers at a cost of $1621.25 secured 1455 subscribers, at an average cost of $1.11.

An increase in the size of space for second insertions failed to develop even as many subscribers as the first insertion with smaller space. This is found to be true not only relatively, but actually, as no second insertion of even more than twice the space

resulted in as many subscribers as the first insertion of half the space.

This campaign is not quoted here because it is unique, for its results will be found to duplicate themselves in subsequent records quoted. It is shown here because of its pertinent reflection of the principles I wish to show, and because the results secured are those of a magazine whose presumed talking points for space embrace the exploitation of a theory it finds impossible to sustain for itself.

The sellers of space are being confronted with advertisers' records that are gradually reflecting actual conditions. The importance of complete scientific records is being constantly recognized by the careful advertiser. The result has been evidence susceptible of little or no doubt relative to most "keyed" publicity. There is still the great mass of "untraced" returns with most keyed campaigns, which present opportunities for the seller of space to keep the superstitions alive. By eliminating this feature of doubt any advertiser will be in a position to convince himself absolutely that there is no such thing as cumulative value as applied to publications. This can be done in almost any advertising campaign which keys results. In my own particular case I have been able to reduce unkeyed results to six-hundredths of one per cent. I will show how this has been done later. It is on account of this approximate accuracy of returns that the records I will show leave no room for conjecture. The chance for specious argument by the seller of space depends on the varying incompleteness of any advertiser's records. The more careless the record keeping the greater chance for the seller of space to hoodwink the advertiser. One man's guess in such a case is about as good as another's. There is no excuse for guessing about results you can prove.

One set of records that will be shown in their entirety will indicate the result to the advertiser of incomplete record keeping. It will show that whereas only about 2 per cent of inquiries were received unkeyed, over 15 per cent of cash was not credited to keys. This discrepancy of about 13 per cent represented money sent by inquirers who had keyed their initial inquiries, but whose

keyed cards could not be found when the money arrived. This was due to a burdensome system of record keeping, as well as a costly and inaccurate one. This 15 per cent represented almost $20,000 in cash. Such a sum blinded the advertiser to the real meaning of his keyed returns, and I am convinced cost him not less than $30,000 in profits he might have had.

Such gaps in accurate record keeping make it easy for the seller of space to pull the wool over the eyes of the advertiser. It is the remaining ragged edge being desperately clung to by the seller of space in attempting to keep the superstition alive with the keyed advertiser. As more advertisers put in dependable record systems the less chance for the publisher to perpetuate the old superstition. He has therefore taken another very clever stand. He is now beginning to admit what he is forced to concede. His admission is something as follows:

"Keyed advertising is 'mail order' copy. It is entirely different than any other kind of advertising. The laws and rules that govern its profitable use do not apply to any other kind of advertising. You have no right to assume that the mental laws governing sales through keyed advertisements are laws of general applicability. If our publications do not present cumulative value for mail order copy it is because the latter is an abominable freak. If your records force an admission from us that keyed copy does not show cumulative value, we will of course admit it. But look at the general publicity copy. It secures cumulative value from us. It is not keyed and nothing can be traced to it. We defy you to prove anything is true about it except what we tell you is true. You will never be able to prove us wrong about general publicity."

In analyzing the possible grounds for any faith in cumulative value we must therefore consider this clever stand of the publication selling pages of space on the strength of it. Before doing so it is not sufficient for me simply to state that there is no cumulative value in my own case. I must prove it in order to warrant any faith greater than that I deplore as the prevailing superstition relative to the other side of the case.

In a later chapter I will show actual records proving the claims made above. Some of them will have a direct bearing on what is

supposed to happen in general publicity appeals. We will try to understand the latter to the limit of the evidence and the apparent facts.

The greatest number of records, in any one business, to be shown in this book are those of The American Collection Service. It is therefore pertinent and desirable that I explain in some detail just what The American Collection Service is. An understanding of the proposition itself will make the records of its growth more clear.

The American Collection Service is a correspondence school. It teaches the collection business, exclusively by mail. In August, 1907, I inserted a classified advertisement in *System* magazine offering to teach the collection business to anyone who desired to learn it. The advertisement was inserted simply as an experiment, as I had made up my mind to enter the advertising field. My knowledge of the collection business was the only thing I could think of that I could possibly sell. With the exception of selling a list of Justices of the Peace, I had never been engaged in selling anything. This "list" was a book entitled *Merchants' Preferred Justices List*, which I tried, unsuccessfully, to sell through salesmen and afterwards "broke even" on by selling through the "direct advertising" plan through letters to credit men.

At the time my first advertisement was published in *System* I had no idea what interest it might arouse, or what I should do if any interest was manifested. I simply wrote the advertisement, sent it to *System*, and waited. As soon as the August issue was out I began to secure inquiries, and soon learned that I was securing them in unheard of numbers. I had prepared nothing to sell, had no follow-up letters written and no advertising literature of any kind to mail. I immediately draughted a synopsis of what a course on the collection business should comprise, and ordered modest literature to be printed. Pending its delivery I composed a first letter and sent postal cards to all inquiries that I was swamped with requests for particulars, but would send full information "as soon as our force caught up with the rush." My first letter with synopsis of the course went out with very modest circular matter about the fifteenth of August, and the advertise-

ment continued in the September issue of *System*. On September 5th I received the first enrolment for the course. I then started to write the course, and delivered it one lesson at a time as I finished writing each. It was the hardest job I ever undertook in my life. During September I enrolled two more students, both long before I had completed the lessons. The first man who enrolled established a collection business that has grown and flourished ever since. It is still conducted in Oklahoma City by an associate of the original student, and has been continuously operated with increasing success from the first day.

Nearly all who take The American Collection Service course join the movement with the object of starting a collection business and of becoming a Coöperative Bureau member. This Coöperative Bureau is composed of all members who comply with the necessary requirements and become representatives of the Bureau. A list of these representatives is printed every month in *Business Service* magazine. Over this list an almost unbelievable volume of collection business passes every month. Any man who takes the course may use the list, and if he uses it he is entitled to a degree of service on collections it is impossible to obtain through any other channel. A large number of business men have taken the course, and they also use the list in sending their collections throughout the country.

The School has really become a movement, and has been successful in every sense of the word. The course is being constantly improved, and with each improvement is usually increased in price. Four increases have been made, the price having gone from $25.00 cash for full membership to $40.00 and from $30.00 in instalments to $50.00.

During the entire existence of The American Collection Service I have experienced an absence from complaints that rarely obtains in any business conducted by correspondence. The course is sold subject to absolutely no return, and no satisfaction is "guaranteed." Nevertheless every one who buys it appears to be more than satisfied with it. I have never had anything but the most unimportant complaints, usually due to misdelivery by the express companies, failure to receive *Business Service* magazine,

or similar minor errors. At one time I accepted payments as small as $5.00, and have had complaints from several of such instalment payers, possibly six in four years. I always returned their money at once without argument. These men usually "kicked" because I would not send them the entire course on payment of $5.00. These complaints have been entirely eliminated, as we now accept $15.00 as the smallest initial payment. I have never had even a suspicion of "trouble" over a complaint. This condition is explained by two facts. In the first place I always manage to give every student a little more than he has contracted for. In the second place he hears from me every month, no matter how long ago he enrolled. He knows I am interested in him and his success, and he knows why. Through his success other students are secured. Each and every member is interested in more members and good members, for every new member means another prospective client, through the business he may send over the directory list. Our follow-up material contains hundreds of letters with pictures of successful students' offices, all due to our training. Any interested inquirer will receive an answer from any of them, and a copy of that letter is almost invariably sent to me the day it is written. This spirit of co-operation could not obtain in an ordinary correspondence school, but the psychological principles behind the kind of treatment every student or inquirer receives is the item of interest for the advertiser. It is costly, but it pays.

In developing The American Collection Service I was handicapped with very few theories of selling, by mail or otherwise. I had never sold anything. My business had never been selling, and I admitted an ignorance of it. I therefore set out to learn how to sell, with the distinct purpose of reducing my results to principles. To do this I determined to be bound by what accurate records would prove, and take no one's word for anything that could be proved. It was largely from the records of The American Collection Service that I deduced the principles on which all advertising done by me is based, as I have found the principles are largely as adaptable to one business as another, although matters of detail will vary in every advertised business.

That the records to follow may be made as intelligible as possible a short outline of the system employed will be given.

The system of advertising record keeping now in use is a refinement of the collection record system employed by me in the collection business for some ten years, which was originally based on the alphabetical system of the Bradstreet Co., and the R. G. Dun and Co., systems, both of which were familiar to me through a mercantile agency experience secured while in the employ of each.

The system consists in a card index that gives the name and address of the inquirer, as well as the key of the advertisement which prompted his inquiry, and a working wrapper that contains a perfect record of all material sent him, which includes copies of all special letters as well as all original letters from him. This system entirely does away with letter filing.

Every inquiry received is recorded and the first letter sent the day the inquiry is received. Every new inquirer receives a regular series of follow-up letters. The number of regular letters in this series varies from four to six. After the regular series of follow-up letters is sent the working wrapper goes in a special file. Tests are made constantly on these files. A letter is tried almost every month on three thousand. If the returns are profitable on three thousand the same letter is sent to the entire list, which numbers about 50,000. A complete record of the number of letters sent out on the regular follow-up will appear later. The same record will also show the number of special "letters" sent out. The latter will show how many have been tried, and how many have been successful. An inquiry once received is sent the regular follow-up and in addition receives about three special letters a year. The inquiries received from our first advertisement are receiving letters today. Good inquiries keep yielding returns every few months, no matter how old the original inquiries. This serves to give the highest credit possible to every advertisement. I know of no business besides The American Collection Service that never ceases writing inquirers and who gives credit to the advertisement that secured them, indefinitely.

Every advertisement of a certain size is given a certain key for each publication. Our second advertisement in *System* magazine

was a classified advertisement keyed 16 State Street. Every subsequent insertion of the same advertisement in *System*, and even those with a slight change in wording, have been keyed 16 State Street ever since. Our first quarter page advertisement in *System* was keyed 15 State Street. Unless some subsequent quarter page advertisement in *System* was of a distinct character deserving an especial key, all quarter page copy in *System* was keyed 15 State Street. Our original half page copy in *System* was keyed 39 State Street, and has been run under the same key repeatedly since, the latest being in 1911. The same system of keying is followed in every publication used. It is clear that were there such a thing as cumulative value in any publication nothing would show it quicker than a system that gives to a piece of copy run in September, 1911, credit for all inquiries received that month and thereafter, as well as every inquiry that might come in from the same piece of copy that had run possibly forty-eight times before under the same key. Every dollar received in September, 1911, from that key, would also reflect the same condition. This system gives the publication the benefit of every doubt, and follows up for it every inquiry as long as the address is correct. In spite of these conditions favorable to the magazines the results will show what little basis there is for considering any publication possessed of an ability to deliver cumulative results.

Some inquiries will always come to an advertiser bearing no key. It is usually this class of inquiries that gives the seller of space an advantage over the advertiser, as one guess about them is as good as another. (You can gamble on what the seller's guess will be.) It is impossible and impractical to attempt learning keys for such inquiries as long as they fail to produce returns. We have devised a system of learning the keys on such of these that buy, however. For four years we have succeeded in crediting the proper publications with every dollar received except in the proportions below:

1907	None
1908	.006 %
1909	.0094 %
1910	.0091 %
1911	.0125 %

The small amounts thus remaining uncredited represent such an inconsiderable total as to be negligible. Of all the enrolments secured I do not think more than three were from men of whom we had no previous record. No money can be entered on our records until the proper clerk finds the card and wrapper. About once a month some enrolment is received for which the records cannot be found immediately. These exceptional cases are usually connected with their proper records in about two hours, although about five in four years have taken about forty-eight hours to turn up. The task of making it easy to connect every enrolment with the proper records is the one rule no employee dares to violate. We therefore have no trouble over them.

One interesting case is worthy of recording. In February, 1909, we received an enrolment from Delhi, India. The money order was pinned to a reprint of a three-page advertisement from *System*, which we had used several months previously in our regular follow-up. We knew some publication was responsible for the enrolment, and we had no previous record of the remitter of the order. We wrote for information relative to the magazine, in which our advertisement had been seen, and secured an answer that no magazine at all had been seen containing the advertisement. Information was given to the effect that remitter had happened to inspect a house just vacated and that therein he had found our reprint of the three-page reader, which included the terms of our course. Thinking this information was all we desired to know, nothing further was furnished, until we wrote a second time and requested the name of the man who had occupied the house. This our student sent, and the name of that man was on our records as having answered an advertisement from key 65 State Street, which was *Harper's Weekly*. We then gave credit to the publication about five months after the money had been secured, and reduced the record of our unkeyed cash $25.00.

I quote this case, as it is more or less interesting in itself and also for the purpose of demonstrating to what lengths we go to secure the proper information, that every publication may be credited with every dollar it could possibly have been the means of securing for us, either directly or indirectly.

Our advertising record consists of a book with sufficient pages to afford a double page for every key ever used and runs from 3 State Street to the highest number on State Street used by us. The record for 1911 at this writing shows a total number of keys of 487. Many of the keys used represent advertisements run in 1907 and 1908, which were never repeated, but to which are credited every dollar resulting from them day to day. As a general follow-up goes to every inquiry at least three times a year, money is constantly secured from the oldest inquirers, and proper credit given.

Our record of each publication shows the entry of every inquiry received every day, every dollar secured each day, also the date and amount paid for the advertisement. The advertisement itself is pasted on the proper page and the totals of previous years shown in the margin. A cost system has been devised that determines at the end of each year just how much it has cost to follow up every inquiry of that year. This cost is our entire cost of business for that year, and represents the difference in total receipts less cash profits and inventory. This net sum is divided by the actual number of inquiries received during the year which gives the average cost of following every inquiry. Advertising, being charged directly to each medium, is of course deducted. This inquiry cost is used as the basis for the ensuing year, at the end of which the entire record is corrected by the actual cost. The difference in actual cost and estimated cost rarely varies to any great extent. It has appeared both safe and liberal to use the cost of an ended year as the basis for the ensuing year.

Our advertising record shows at the end of each month, for each key, the following information: Number of inquiries received. Amount of money secured. Amount spent in advertising that month on each key. To the amount of advertising is added the cost to follow up each inquiry and this sum represents the total cost for the month. This sum subtracted from the total cash secured each month gives the net profit for that month on that key. If the sum taken in shows a less amount than the total cost the result shows the net loss for the month. The totals for each

month are carried forward and the total loss or total profit show for the entire period at the end of each month.

To make it easy to see just what any publication has done we transfer the totals every month to cards alphabetically arranged as to publications, one card for each publication. These cards show a record of results for every key used in any publication. All ordering is done from the cards.

The system of charging each inquiry with a certain amount is a system overlooked by all but a very few advertisers. A cost system is operated by practically every advertiser with the slightest business training, but the operation of these various systems, for the most part, is confined to actual sales. It is evident to any one that every inquiry received costs something to answer. The cost system above outlined charges every inquiry received with the average sum of doing business, which is the only fair basis for a business dependent entirely on the follow-up of inquiries. So few realize that inquiries are a liability that charging a publication with them rarely occurs to the advertiser, yet a definite, exact provision must be made for this expense, if dependable records are to be relied on for the success of an advertising campaign. One advertiser, whose complete records will be shown, made the great mistake of simply subtracting from the cash returns of any advertisement the amount spent for the advertisement itself. As a result he continued to run advertisements in a large number of publications because he saw from his records that he was continually taking in a little more money than the advertisements cost him, and he thus "guessed" they were yielding a profit. As he had failed to charge anything against every inquiry secured he had been running a large number of showings that proved to be almost dead losses to him from one year's end to the other. Any advertiser who fails to run a cost system against his inquiries is likely to waste a great deal of money, as some publications will pull inquiries to a remarkable degree, and even return more money than the advertisements themselves cost, and still lose a great deal for the advertiser, in following up a large number of unproductive inquiries constantly.

XXV. Making Each Medium Pull Its Share of the Load [1]

By John P. Wilder

How many advertisers, I wonder, are reasonably certain that the expenditure for space and copy is pulling its fair share of the sales load ? How many can produce the figures to show that a certain combination of mediums is productive of better results than a certain other combination, differing from the first perhaps in only one or two publications ? Of course, in the case of a purely mail-order business it is easy to figure a publication's productivity on the basis of cost per inquiry and percentage of sales. But when the goods are handled by local dealers it is a more difficult matter to tell whether this publication or that is more influential in turning over actual sales.

Naturally enough, when the business amounts to several millions a year and the appropriation is up well beyond the six-figure mark, a little difference in pulling power between two general publicity mediums doesn't cut much figure. If the rate of increase of the gross sales keeps up, everybody is satisfied, including the board of directors, and it isn't necessary to be sure that every dollar works with maximum efficiency. But when the proposition is yet small, and while the boss is inclined to feel that the first place to retrench is in the advertising appropriation, the pulling power of one publication over another becomes a matter of immediate importance.

I have heard it said over and over again that you can't measure the pulling power of a publication when the goods are sold through jobbers and dealers. It is a common saying that general publicity has to be taken on faith—if the sales increase, it is good advertising, and if they don't it isn't. Maybe so, yet I know of one concern in New York City — the John Simmons Company — which is making an attempt to approximate the relative values of a rather long list of mediums, while the goods are going through the jobber and dealer.

[1] *Printers' Ink*, March 20, 1913, pp. 26–28. Reprinted by permission of *Printers' Ink*.

This concern, in addition to an extensive line of general hardware, distributes the Baldwin lamp, which is a very simple arrangement for generating and burning acetylene gas. For several years the company sold this lamp to miners, as a substitute for oil lamps, and it became a sort of standard article handled by mine supply dealers. Since it was a staple and since each dealer had from two to twelve hundred customers more or less constantly in the market for it, the retail price was set at a dollar, of which twenty-five cents was profit to the dealer, to whom the goods were sold direct.

Later on, however, it was found that there was a certain demand for a portable lamp for use out of doors — by hunters, campers, trappers, and as a substitute for the old oil lantern used by farmers. The moment the company tried to enter this field, however, it found that the 25 per cent of profit was low and that dealers did not take kindly to the proposition. When sold as a staple the price was all right, but the moment a dealer was asked to handle the lamp as a specialty he demanded a wider margin.

Of course, it was not possible to reduce the wholesale price to one class of dealers without lowering it to all classes, and it was equally impossible to put over a raise in the retail price. It didn't look like a very promising field, and the company inaugurated the campaign of advertising the lamps for outdoor use with a good many misgivings. A good-sized list of mediums was chosen — outdoor publications, weeklies and hardware trade papers — but very small space was used, mostly from one inch to thirty-five lines.

The copy went directly after inquiries. As fast as they were received letters were sent to local dealers telling them of the inquiries and offering to fill orders for single lamps at the wholesale price. At the same time the customers were directed to inquire of these particular dealers. Gradually in this way dealers were encouraged to stock the lamps.

After a year the jobbers began to inquire after the line, and it was finally thrown open to them, the company still continuing to sell direct in response to inquiries which the copy still requests.

When the campaign was inaugurated the company said it would be satisfied if 5,000 lamps were sold the first year in addition to the mine business. That first year the sales amounted to 11,000 lamps, and last year more than 50,000 were sold for outdoor use. The company is just beginning to go after the farm trade, after three years of consistent emphasis of the advantages of the lamps for use by sportsmen and campers.

From the foregoing it is easy to see that it was highly important to the company to know the relative pulling power of the publications used, where that power was strongest and where weakest. Particularly after some sales began to be made through dealers without any direct inquiries, it became necessary to check returns on a basis of something besides cost per inquiry. No money could be wasted, because the lamp business was only a small part of a large concern, and if it didn't show a profit the advertising would be cut down, if not stopped entirely. Hence a publication which wasn't pulling inquiries couldn't be cut off the list just on that account, because it might be sending customers to the dealers; and, on the other hand, the company couldn't afford to keep it on the supposition that perhaps it was influencing dealer sales. In other words, inquiries from *Collier's* might cost two dollars apiece, as against forty cents from *Field and Stream*, and it wouldn't necessarily indicate that the former should be dropped, even if they were all turned into direct sales.

The following method has been adopted of judging the relative values of the mediums used. As to whether it is thoroughly reliable in all cases or not there is, of course, plenty of room for argument. Probably the publisher who finds himself left off will argue that it is not fair, and he who is retained will swear by the system. At any rate, it can't be any worse than the pure guesswork which is relied upon more often than it ought to be.

When an inquiry is received it is credited to the publication, whose key number is used, in the regular way. A chart of inquiries is made by months, so as to indicate any seasonable appeal, and at the end of the year a recapitulation is made, showing the cost per inquiry and the cost per sale.

A ruled sheet has the key numbers down the left-hand side, and the names of the various states across the top. On this sheet are entered the number of inquiries received from each publication from each state during the year.

On a third sheet the names of the states are set down in order, together with the total number of inquiries received from each during the year. In a second column is placed the total number of lamps sold direct to dealers in each state during the year.

The way the system works is this: Suppose that from Missouri it is noticed that the total number of inquiries was seventy-nine and the dealer sales 1,500. That indicates that the publications which are strong in Missouri are sending more customers to dealers than are inquiring direct. By running down the column headed " Missouri " on the sheet giving totals by states, it is easy to tell which publications are strongest in that state.

In Nebraska, let us say, the dealer sales are 'way below the direct inquiries. The publications which are strong there are sending more business direct. It is easy to find out which those publications are. In fact, the tables tell which publications are strongest in each state, and the relation of dealer sales to direct sales in each state. Taking this information in connection with the cost per inquiry and the cost per sale for each publication, figured on the basis of direct sales, the company thinks it can tell pretty accurately which publications to drop and which to continue.

With the understanding that the cost per sale figured on direct inquiries is not always just, however, the company sends return postcards to all " dead " inquiries from publications whose cost is apparently high. These cards offer a new set of fittings for the lamp in return for information as to whether the customer has bought from a dealer since sending in the inquiry direct, and the dealer's name. All such sales are credited to the publication. This method is not followed with publications whose cost per sale is low, because the only object of the information is to determine the advisability of dropping a publication from the list. The company says that 80 per cent of the cards are returned, and it believes the returns are accurate, since the fittings offered would

be of no earthly use to anyone who did not own a lamp of the particular make.

Of course, the company does not regard the plan as infallible, but is willing to let the sales records speak for the efficiency of it. The charts are used to determine even such comparatively minor questions as whether to continue 35-line copy in a certain publication or to increase to 56 lines. If it doesn't do anything else, it gives the man who is responsible for the advertising a basis upon which to demonstrate the necessity for keeping the appropriation from going down hill.

XXVI. Fallacy of Rating Mediums on Inquiry Basis[1]

By Luther D. Fernald

The value of a strong inquiry-attachment as a means of helping to sell goods sold through dealers is debatable; I personally think there is frequently a mistaken emphasis on inquiries, to such an extent that the very best possible result — the actual purchase of the merchandise from a dealer — is subordinated.

In other cases inquiries, properly made secondary, do serve the useful purpose of gleaning an additional harvest out of the advertising, after the main crop of results has been harvested through normal channels — the retail trade.

But for advertisers of products sold through dealers the inquiry test of the value of mediums is fallacious. For the advertiser is buying sales, not inquiries, and yet, being unable to count sales, he would count inquiries. The only man who can gauge the value of a medium positively is the mail-order advertiser, who judges publications not on the number of replies, but on the number of sales.

As a matter of fact, the wise mail-order advertiser cuts off the publication which produces too many inquiries, if the number of inquiries is too great in proportion to sales. The high cost of following up inquiries will offset a low cost of getting them, and result in a too-high cost per sale as compared with other publica-

[1] *Printers' Ink*, November 20, 1913, pp. 104–109. Reprinted by permission of *Printers' Ink*.

tions whose inquiries come from buyers instead of mere inquiries. His best publications are the ones producing as few as possible waste inquiries.

But the advertiser who sells through dealers has no sales test, and gives the prize to the publication producing inquiries at the lowest cost.

Now the mail-order man has to have inquiries to make sales. The only way people can buy his goods is to write to him. If people don't write him he doesn't sell them.

On the other hand, the easiest and best way for the consumer to get the dealer-sold merchandise he sees advertised is to go to a dealer and buy it. Yet some advertisers, wanting people to go to their dealers to do their buying, nevertheless put a premium on the publications whose readers do not do this very thing. They praise the publications which bring them lots of inquiries, and condemn those that don't.

A 100 per cent efficient medium, reaching only people who could buy and use an advertiser's goods, and living where the goods themselves are readily in sight and on sale, would do its work in sending people into the stores to ask for the goods, instead of writing for some pictures of them. A medium reaching only people who could buy his goods, but 50 per cent of whom live where the goods are not distributed, would produce a great many more inquiries. Inquiries in this case would probably simply indicate what percentage of the publication's circulation was outside the regular course of trade.

On the other hand, a third publication, with 50 per cent of its readers good prospects living where the goods were well sold, would have in the other 50 per cent a great many non-prospects. If the "bait" for the inquiry is as strong as it frequently is, it is more likely to draw inquiries from the curious, bargain-hunters, etc. (both children and grown-ups), among the 50 per cent non-prospects, than it is from the 50 per cent real prospects.

My point is not that no inquiries are any good, but that inquiries are never 100 per cent good; and that what is usually an unsafe test for the mail-order advertiser, whose whole business must be done through inquiries by mail, is always an unsafe test

for the advertiser whose best inquiries are those made to his dealers — whose mail inquiries are incidental rather than fundamental, and who has no final test of sales, but merely the fiction of " the law of averages " to fall back on.

The mail-order man says: " Write for my catalogue — the only way to get the goods I sell." Yet even he can't judge mediums by inquiries.

While some national advertisers say: " Go to the dealer for our goods " — and then judge their mediums by the number of people who write for a catalogue, or even a calendar or puzzle!

When I heard of a campaign which combined the essential features of both a mail-order campaign requiring inquiries and tracing sales, and a dealer campaign having national distribution of the article sold, I knew that its showings would be of unusual value in proving the fallacy of the inquiry-test.

I am going to give you the actual facts of this campaign. By not divulging the advertiser's name, more exact information can be given than would be otherwise possible. But I have detailed proofs of every point for anyone who wants them.

The records I quote from cover the last and largest complete season, with an appropriation of $55,000, in fifteen great national mediums. Campaigns of two previous seasons also bear out these findings.

The proposition advertised was a set of books ranging in price from popular editions of $35 to $60 up to sets in more expensive limited editions in finer bindings, running to several hundred dollars.

The advertiser had sold books by canvassers all over the country for years, and had a selling staff equivalent to very good distribution for an ordinary article of merchandise. This particular set was not, however, sold by booksellers.

While he intended to follow up every inquiry either by a canvasser's personal call, or by a strong mail follow-up, he realized that the way for many sales made by his sales organization would be paved by this advertising, even though not traceable directly to advertising.

The inquiry appeal was, however, made strong, as the only way one could secure the books would be from the publisher or his canvassers. At the same time he made his copy large and its appeal strong, to pre-sell its readers as much as possible, and cut curiosity inquiries to the minimum.

All inquiries were, if possible, followed up by canvassers, using the inquiry as an invitation to call. Inquiries out of reach of the selling organization were followed up by mail. The great majority of inquiries were followed by salesmen, and most of the sales were made by personal canvass.

This rather elaborate preliminary is given to show the bearing of this campaign where results could be traced to the average general publicity campaign with an inquiry attachment where the very best possible result — the actual purchase of the goods from the dealer — never comes to the advertiser's attention at all.

The manufacturer of shirts or toilet accessories, or ice cream freezers, or motorcycles, or food products, has hundreds or thousands of retailers selling his product.

His distribution is equivalent to the book advertiser's distribution, except that his distribution is usually evident to the average buyer of goods at stores, while the only way the consumer could get this publisher's product was by writing him or by having a canvasser happen to call on him.

Actually the usefulness of inquiries was far greater to this publisher than to any general advertiser selling through stores. They were as necessary a part of his selling plan as they frequently are a positive hindrance to sales on generally distributed products.

The main point is that even if this advertiser had judged his mediums, his dates of insertions, his sizes of copy, solely by inquiries he would have been as far from knowing the real worth of each correctly as the average advertiser who counts inquiries but can't count sales.

Now, what was the medium which proved to be the most efficient medium per dollar expended? Was it the lowest in cost of inquiry? Was it next to lowest? Was it the third, fourth or fifth? None of these.

The publication first in low cost per sale was eleventh in rank in cost of inquiries.

On the other hand, the medium first in inquiry cost was fourth in sales cost.

The sixth publication in cost per inquiry was third in cost per sale.

The third in cost per inquiry was fifth in cost per sale.

The fourth in the inquiry list was eighth in the sales list.

The ninth in inquiry cost was fifteenth in sales cost.

Other inquiry rankings are about as poorly indicative of traceable sales value. There is not even any consistency of inconsistency. You can establish nothing from this showing — except that: The number of inquiries simply proves nothing at all about number of sales.

In only one case would the rule-of-thumb method have hit it right; the publication second in inquiry cost was also second in sales cost. One case out of fifteen!

Here are some more tests of the inquiry-test:

All except two inquiries from one medium were called on by canvassers; these two were followed by mail and each person bought a set. Fifteen from another were followed up in the same way, and one sale resulted. Thirty-one from another produced no sales at all. Ninety-five from another produced one sale. One set was sold among another publication's 188 inquiries followed by mail.

Other inquiries numbering 399 from three insertions in one publication produced $435 in sales, while 38 inquiries from one insertion in another produced $513.

As in other cases, the inquiry-test would have cut off the real producer.

Try this on your inquiry-test: Cost of inquiry for publication A was half as high as for B, and one-fourth as high as for C; yet A cost 12 per cent more per dollar of sales than B, and 16 per cent more than C.

Is an inquiry an inquiry for all that?

But I am not through yet. Some advertisers I know would have thrown up their hands in holy horror at, and rushed a can-

cellation to the medium which cost over $25 an inquiry one month. Yet each of these $25 inquiries meant eighty times as much money for the advertiser as another publication's $2.50 inquiries.

Verily an inquiry in the mail is no indication of a buyer in the store.

Another example: One piece of copy in one publication produced nearly twice as many inquiries as another piece of copy of the same size run shortly after. The inquiry-test would have proved the second copy weak or run too close to the first. The second copy, with half as many inquiries, resulted in $53 more sales than the first — and both did well.

Another: The same copy which produced phenomenal returns of 2,359 inquiries from one publication produced only 401 from the other. Inquiry cost on the 2,359 was the low record of the campaign. The 401 inquiries cost over four times as much per inquiry.

But 401 inquiries spent exactly $45 more with the advertiser than the other 2,359 did.

But why go further? In the light of such facts as these, may I not be so bold as to suggest that the little inquiry book kept by the $6 or $8 a week girl is not the infallible and final answer on advertising mediums that you may have thought it is?

May I be so bold as to suggest that it be regarded as an interesting sidelight on your advertising — perhaps a danger-signal system — but not a substitute for your own and your advertising agent's good gray matter in picking the advertising mediums in which you spend your thousands or hundreds of thousands of dollars, in not only helping your dealers sell your goods now, but also in making that permanent investment in the minds and memories of the people which makes good advertising a real investment rather than an expense?

XXVII. Why Cost Per Inquiry is a Bad Guide[1]

By S. R. McKelvie

The article by Robert Frothingham, regarding cost per inquiry, in a recent issue of *Printers' Ink*, was one of the most able discussions I have ever read. It prompts me to offer some further argument along the same line.

I have in mind a certain large advertiser, whose distribution is practically entirely through regular trade channels— jobbers and retailers — who absolutely insists that he must have inquiries.

First, to judge the relative strength of his various advertisements and appeals; second, to determine the advertising value of mediums he uses.

Let me first eliminate from this consideration mail-order houses. These (with a few exceptions) — since they depend entirely on inquiries to promote their sales — are probably justified in using the "cost-per-inquiry" rule. (The exceptions would be those few very large mail-order houses whose advertising, by reason of the tremendous number of catalogues they have already distributed, becomes in the nature of "publicity" advertising. Their catalogue bears the same relation to them as does the dealer to you.)

But with reference to the advertiser who sells through dealers, I honestly and sincerely believe that "cost-per-inquiry" as a means of determining advertising value is an absolute fallacy. Mind you, this is no-fly-by-night idea or theory — I have been working on this subject for four years.

And here are my reasons for believing as I do with regard to so-called "publicity" advertising:

1. The copy itself is an absolute barrier against the "cost-per-inquiry" plan. To assure the dealer that the advertising is being done for his (the dealer's) benefit, the advertiser says in 72-point black-face type: "Ask your dealer" or "For sale by all dealers." In 6-point light-face Roman type he says: "Send to me for catalogue XY1309."

[1] *Printers' Ink*, February 27, 1913, pp. 107–112. Reprinted by permission of *Printers' Ink*.

2. Certain high-character publications — farm and city papers — are doing and have for some time done extensive promotion work in the interest of manufacturers selling through dealers. These publications are educating their readers as to the importance of buying trade-marked goods. Since such goods are handled practically entirely by dealers, it stands to reason that this promotion work tends immediately to send the prospect to the dealer and to reduce to a minimum the writing for catalogues, booklets, etc., by the reader.

There is no adequate reason why the prospective purchaser of an article advertised as "For sale by all dealers" should write for a catalogue. Look at the question from this standpoint.

Why should anyone take the time to write for a catalogue, wait for a reply, then go to his dealer to inspect and buy the article? Why should he? In the end he goes to the dealer anyway. Why, then, waste time writing and waiting for a catalogue — two entirely superfluous operations? Why should he?

Here is Bill Brown, for instance. He has been thinking some of buying an article which is extensively advertised by two large companies. He is just feeling in the buying mood, when he reads your advertisement offering this article. He reads, "For sale by all dealers." He knows he wants such an article. It is, therefore, just a question with him whether or not yours is as good as the other fellow's. But "For sale by all dealers." Do you suppose for one moment that Bill Brown is going to heed your next suggestion, "Write for my catalogue"? Well, he won't! He has confidence in the paper that carried your advertisement; he rather "suspects" that you are reliable. What he wants to know about your product he can find out by "asking his dealer," and with less time and trouble, certainly, than he could by first writing to you, waiting for your reply, and then calling on the dealer anyway.

I tell you, full-grown men and women of normal intelligence do not read their favorite periodicals with pencil and paper in hand, waiting for the opportunity to write for a catalogue; that's a certainty. You tell them: "Here, you need this article, it's advantages are so and so, it's made so and so, and you can get detailed information from your dealer."

Why, then, should that reader send for your catalogue?

Well, perhaps you will say: "But I offer the reader a valuable book free. Why shouldn't he ask for it?"

Take the case of Bill Brown again. He's in the market for your product. He sees your advertisement. He knows that he can get complete information about your product "at his dealer's." He will probably do so. If he sends for your catalogue first, does that indicate that he's a better prospect?

Well, then, isn't it reasonable that the working out of advertising plans according to the "dope" sheet is not only an absolute fallacy, but will, in many, many cases, operate against the best interests of the advertiser?

But the advertiser says: "If I do not solicit and receive inquiries, how can I judge the value of mediums or copy?"

I shall answer in Yankee fashion, with another question: "Do you honestly believe in advertising?"

If you don't, quit. And quickly! If you think that money spent for advertising is a "necessary expense" — Quit!

And it is my belief that the average "publicity" advertiser who is always watching the "dope" sheet falls in that category. He credits all increase in sales not directly traceable to an advertisement exclusively to the efforts of his salesmen. Only inquiries showing that they were prompted by an advertisement are credited to advertising. And when he has sent a catalogue, and no sales are made directly to those inquiries, "advertising is a failure."

But, if you are a member of the other class (and I'm glad to believe that then you will be with the majority), if you are one of those advertisers who have a whole-hearted belief in the value of advertising, then you will believe also in the value of those things that make advertising an active and compelling force in the sales department of your house.

And that means, I believe, that you will not watch the "dope" sheet on inquiries, but will watch the record of your sales, which is the only real test.

For three years, we will say, you have been selling around \$10,000 worth of your goods in the state of Nebraska, at sales expense of \$1,000.

Then you spend $1,000 in advertising your product to the people in Nebraska most likely to buy of your dealers. Following this investment in advertising of $1,000, your Nebraska sales reach $20,000. What matter if you never get an inquiry? Would you not be willing to give your investment of $1,000 for advertising credit for the increase? Of course you would.

Now then, this brings us back to finding a substitute for the "cost-per-inquiry" fallacy.

"What copy?" has been discussed so frequently in *Printers' Ink*, before advertising clubs and in other advertising trade journals, and each individual advertiser has his own problems to meet in preparation of copy, that I shall not touch on this subject now.

Nor can there be an infallible rule by which to judge mediums. A few general principles, at least, will apply to almost all cases.

1. What class or classes of mediums will reach the people who are your prospects? Shall it be newspapers, magazines, farm papers, billboards, street cars, etc.?

2. Having selected, for instance, farm papers as probably reaching the largest proportion of your prospects, you must decide what farm paper most effectively and most economically covers your territory.

(*a*) What percentage of its circulation is in your territory?

(*b*) What percentage of its circulation is "home circulation," i. e., in the restricted territory whose good interests that publication can serve reasonably well?

(*c*) How is that circulation secured, both "at home" and in outside territory?

(*d*) What is the publication's standing in its community, and among its subscribers?

(*e*) Who pays for the paper? Does the reader himself pay for it, or is its circulation secured by selling yearly subscriptions at wholesale to banks, manufacturers, etc.?

(*f*) Why is it bought? Because it is wanted — a necessity — and therefore paid for by the reader himself, or because of the offer of a free premium or of a half dozen publications all for the price of one? Or is the paper paid for because the reader needs a

pocket-knife, shotgun, suit of clothes, or a piano, anyway, and can virtually get the paper free, and so takes it to use for kindling?

And finally, the advertiser must determine from a consideration of all these things whether that particular paper is the logical one for him to use. The advertiser has a right to all this information, and every legitimate publication will be glad to furnish it.

Based on the " record of results," many an advertising campaign has been a total failure. Based on a careful study of the advertising problems along the line of suggestions I have made, using only good media and carefully preparing 100-per-cent-right copy, every campaign will be a success.

Along the line of the quality of circulation, as I have just stated, I have recently conducted an investigation which emphasizes most emphatically that the publication which stands highest in its territory is not always the one that will bring the most inquiries. From thirty-three letters received from farmer-owners of automobiles, in which the question was asked, " What is your favorite farm paper ? " the results were as follows: The total number of publications mentioned as favorites was fourteen, and the number of times each was mentioned ranked as follows: 13–3–3–3–2–2–1–1–1–1–1–1–1–1.

Of the publications mentioned, two are rated as having circulations of over 6,000,000; four are rated as having over 1,000,000, and the majority of the balance are rated as having over 50,000 circulation, except the publication which was named thirteen times as the favorite, and it has a circulation of less than 45,000.

In a competitive showing on " cost-per-inquiry," the publication which was named thirteen times in this investigation would rarely be at the top of the list, and yet no advertiser will deny that the very fact that it was named thirteen times, or more than four times as many times as any other publication in the list, gives it an indelible stamp as the very best medium to use in the territory which it covers.

I should hasten to add in connection with the test to which I have just referred that in making the investigation, a double postal card was used, with nothing to indicate whence the request for information came. The inquiry was as follows:—

One of the largest problems in selling automobiles is that of advertising.

I want to know how I can best advertise to the class of farmers who buy automobiles. I understand that you are an automobile owner and that you are a farmer.

So I am going to ask you to answer just one question:

What is your favorite farm paper?

I have nothing to sell to you, and to assure you that I mean this, I am not signing my name, nor do I ask you to sign yours.

Just answer this one question on the enclosed postal, and you will be doing me a great favor.

Yours with thanks,

P. O. Box 488, Lincoln, Nebraska.

The only inscription on the return postal card was the post office box number and address and "My favorite farm paper is ——————." This was done so that no favoritism could possibly be shown because of the source of inquiry being known. And I therefore consider that the test was absolutely fair to all publications.

Therefore, in renewing my statement that "cost-per-inquiry" as a means of determining the correct mediums to use is not only a fallacy but one of the greatest enemies of successful advertising, it is fair to draw the following conclusions: —

1. Copy itself is a barrier.

2. The "dope" sheet is not a judge of mediums, owing to the very great difference in various methods of securing circulation.

3. It isn't reasonable to expect a good prospect first to write, then wait for a catalogue, when he would much rather go to the dealer at once, and could do so with much less inconvenience to himself.

4. Because those papers — often the cheapest class of near-free circulation, mail-order publications — which by their very method of securing circulation educate their readers to write for "beautiful illustrated booklets absolutely free" are at the very head of the "dope" sheet.

5. Because the advertiser who follows the "dope" sheet will be compelled almost invariably to cut out the mediums which are giving him the largest measure of coöperation as between himself and the dealer. Naturally, that result tends to dampen the ardor of publications engaged in this coöperative dealer work.

XXVIII. Forecasting Results of Sales Letters[1]

By H. McJohnston

"Here are three letters; be sure to give them all the same test," said the copy chief in a Western advertising agency to a manufacturer of medical appliances, who was starting a special mail-sales campaign direct to physicians and surgeons.

"But I asked you to prepare only one letter," replied the manufacturer. "I do not want any follow-ups on this first mailing until I see how the first letter pulls — until I get in some replies to guide us in making the follow-ups more effective. And I wanted to test the ability of your copy department by the way this first letter takes hold before letting you prepare other letters or handle other parts of my advertising, just as I told you."

The copy chief listened patiently; then asked the manufacturer to read the three letters carefully, and again waited.

"You don't call this a follow-up series?" the prospective client soon questioned. "They are pretty much alike. In fact, either one of them ought to make a fairly good first letter, if my judgment is worth anything."

"Glad to hear you say it; that's just what they are," smiled the copy chief. "Give them all the same test; use the one that pulls best on your big list of names. If you don't get a pay test out of either of them, let me know and we'll try again. You told us that if we got up a first letter that would pull satisfactorily you would very likely let us handle your account. We are not taking any chances. Anyway, the day of hit-or-miss circular letters is gone.

"You know from experience, just as we do," he continued, "that it is unsafe, unsatisfactory and often impossible to judge the 'pull' in a letter or an advertisement before it is put to the test. Therefore, whenever it is possible — usually it is — we advise a test of letters, the value of which depends upon direct results, before the letter is mailed to a big list."

[1] *Printers' Ink*, February 27, 1913, pp. 59–63. Reprinted by permission of *Printers' Ink*.

Then the copy chief explained in detail how the three letters were to be sent to three small test lists of names — five hundred names in each, fifty of which were to be chosen from each of ten different states, in order to make the test lists average up as nearly as possible to the big list with respect to conditions. He also impressed the advisability of sending each of the three letters to three equally typical test lists at the same time.

The manufacturer became enthusiastic. He was asked to pick out the letter he thought would pull best in the test. The copy chief concurred with his choice. But the test showed that this letter, though it had been the most carefully prepared of the three, was poorest in pulling power; while the one they considered the poorest pulled far beyond expectations.

Furthermore, it pulled the same percentage of returns when sent to the big list of some thirty thousand names — and this manufacturer's account is now solid with this agency, as are many other accounts, because it stopped guessing.

The foregoing incident, which happened about one year ago, illustrates another important application of scientific methods to advertising. It, of course, is simply the ancient mathematical law of averages applied to sales letters for the sake of certainty. In most cases of the circularizing of large lists of names by means of form letters, the " test letter " makes possible a fairly accurate forecast of returns.

Shake a perfectly-balanced die with only " one " and " two " spots alternately placed on its six faces from a dice box onto a smooth, level surface ten times, and the count may stand ten " ones " and no " twos " — though it is likely to be nearer five " ones " and five " twos "; but shake one hundred times and the ratio of "ones" in comparison to "twos" will be more nearly equal. Shake a thousand times and the ratio of difference grows less; and the greater the number of shakes, the less will be the ratio of difference between the " ones " and the " twos."

That is a crude illustration of the law of averages. Applied to the form sales letter, it might be stated like this:

Given a certain result of a certain sales letter sent to a fraction of a list of names, chosen so that they will be typically repre-

sentative of the entire list, and the ratio of result will be approximately the same when the same letter is sent to the entire list under the same, or more favorable, conditions.

The word "approximately" is used not because the law of averages is erratic, but because it is seldom possible more than to approximate in the big mailing the same conditions that existed in the test. Experience reveals a hundred and one things that might operate to change conditions and make them more or less favorable to results. That is the primal requisite — to be sure that the conditions of the test and the "big mailing" are as nearly as possible alike; for when the percentage of results varies noticeably, the cause usually may be traced to varying conditions.

Recently, out of six big mailings in one concern that sells books by mail to various classes of men, the results of only one showed a difference of as much as one per cent in comparison with returns on five hundred test letters. In this one case approximately fifty thousand names were on the entire list, out of which the letter pulled 990 orders, or approximately two per cent; while on the test only eleven orders, or about one per cent returns were received.

At least one per cent returns were needed to make it a "pay test." It just squeezed through the barrier — a cold, accurate cost calculation, including all overhead expense. The net profits on the sales that letter made, not figuring in the selling cost, just a little more than balanced that selling cost.

Under ordinary conditions this "pay letter" did not pay enough net — net profit over all expenses — to warrant sending it out. But the sales manager knew that the mailing on the big list would be made under more favorable conditions than prevailed when the test was made; for the test went out in November, while the "big list" was mailed early in December — nearer the holidays, the time when folks would be more likely to buy this particular set of books.

Thus the seasons of the year are important varying factors, but broad and, as a rule, easily avoided. Narrow it down. Take a letter designed to sell overcoats. Just because it pulls November 1 is not necessarily proof that it will pull November 21, when a general warm wave may have struck the territory covered,

whereas on November 1, it was biting cold throughout that territory. Thus weather conditions are an extremely important factor. In the case of the book letter test already mentioned, it was colder in December, as well as nearer the holidays. Folks feel more like reading in cold weather than they do in warm. That also was one of this sales manager's minor considerations.

Various classes of people spend their money more readily at various times of the year for various things and for various reasons. After a good crop year the time to go after the farmer is late in the fall, except, perhaps, in the extreme South or North. The best time to drum the average merchant on something new is just after a lucrative holiday season, if business conditions have not been affected by bad weather, strikes, crop shortages and so on, which suggests business conditions to be another important varying factor. These conditions, including a potent fluctuation cause, weather, can be estimated with reasonable accuracy from Government bulletins, reports and the bulletins of commercial agencies, also from salesmen and the correspondence.

Of course, the main point as applied to test letters is that all these varying factors must be the same, or more favorable, at the time of the " big mailing " as when the test is made.

If possible, it is found better to make the test under slightly adverse conditions — never, however, forgetting to consider this handicap, should the letter not pay in the test; for the difference in conditions might make it the most profitable letter available for the big mailing. The mail salesman must remember that varied conditions may be more favorable as well as less. Otherwise, many a tested letter that could earn big profits might be discarded.

Often minute points will change the results of a letter from profit to loss. A manufacturer of aluminum ware put out a thousand test letters offering a " Starter Assortment " to retail dealers. It was a fair test and the results paid well. The same offer was made to a list of twenty thousand names of dealers in Eastern and Central Western States. But the " big mailing " fell far short of the test record, though it paid a profit.

There was no blizzard nor bad weather in the East or West, the local business conditions throughout the entire territory were good so far as could be learned. Apparently conditions were identical with those that obtained when the test was sent out. The failure of the law of averages to hold true was a mystery — until the mail-sales manager of this concern observed that the test letters had been mailed on Monday, and reached their destination on Tuesday or Wednesday; a few of them on Thursday; whereas the greatest part of the " big mailing " had been put into the mails on Friday, reaching a majority of the retailers on Saturday — the busy day — while no doubt some of the letters reached port on Sunday, to be tossed into the waste basket on account of the added accumulation of mail that usually arrives on Monday. Later tests proved conclusively that this was the cause of the difference.

There are dozens of other factors to be considered in specific cases. Their consideration is what makes the test letter valuable. Some men have objected that there is not time for testing. But the time element can be handled accurately with few, if any, exceptions, although it be necessary to mail the test under slightly less favorable conditions.

" It's a matter of good judgment in determining the possible difference in results by carefully weighing all the varying conditions and factors that might change results," says the advertising man first quoted. " But this requires a consideration of past experiences and records and an exercise of sound sense in no greater degree than is required to solve hundreds of other business problems. And the twofold benefit — guard against loss on the one hand, and assurance of sales on the other — makes this problem involved in harnessing the test letter system to the average business that sells by letter well worth solution.

" The idea back of this growing practice is sound," he continued, " although this assertion is easier to demonstrate by actual experience than by theoretical reasoning. That may be why the scientific test-letter idea has been slow in taking root."

Experience — and experience alone — must, and has for many businesses, established the degree of similarity of conditions,

including the quantity of names necessary to make the results of effort that differ for the main part only in quantity average up near enough alike for practical purposes. The number of names necessary to make the test safe varies, and is also fixed by experience. Few concerns find it necessary to use more than one per cent of the total for the test. Much more important than the number of names in the test, however, is, as already emphasized, the similarity of conditions, and how nearly the test names typify the entire list.

The necessity of all this caution gives the test letter added value; it compels attention to many otherwise neglected factors that have much to do with the success of a form sales letter. For one thing, it lets a man write freely and naturally without that feeling of the tremendous responsibility of having to write a letter that must either pull or lose considerable money; for many a sales letter has failed to pull because it was "too good" — worked and stewed and fumed over until all the action-compelling naturalness was worked out.

The main value of the test letter, however, is not the fact that the necessary comparison of all the conditions of the test with those of the "big mailing" requires a thorough analysis of actual conditions. The big point — so big and important as to stagger the business man now experiencing it—is this: The test letter practically eliminates uncertainty; it avoids waste, and by the same stroke builds sales.

XXIX. Retail Control through Sales Records [1]

By A. W. Montgomery

Fluctuation in the volume of business by departments is the one objective on which the general manager of a many-line store constantly keeps his eye. There may be many side issues, such as adjusting complaints, encouraging employees and altering methods and plans, but constantly his attention reverts to the barometer of trade. What does it register? If below a certain mark, what is the trouble? If above, why? He must know the

[1] *Library of Business Practice*, vol. 5, pp. 188–200. Reprinted by permission of A. W. Shaw Company. Illustrations of forms are omitted.

reason for variations. His ability to expand the business largely depends upon the accuracy with which he senses the cause of conditions.

Department One may show by its daily report sales of $1,100 in excess of the sales for the corresponding day a year previous. This gain may have been due to any one of several causes: an advanced season on the line carried, heavier advertising, special sales and so forth; or it may have been due to a combination of causes. On the other hand, Department Two may show sales $900 less than last season. The reason for the loss may have been a backward season, generally depressed business, insufficient advertising and so forth. In either event the actual causes for the gain or loss must be determined.

Furthermore, for the previous season, a period that covers six months, Department One may have failed by 15 per cent to equal the sales of the season prior to it. Department Two, conversely, may have gained 20 per cent over the preceding season. In comparison with the one daily report already mentioned, this is paradoxical, but averages taken over long periods will explain.

A summary of the causes underlying daily fluctuations for the entire season serves as a basis for determining the reasons for a total gain or loss. And these season-causes must be determined by watching daily sales in each department. The daily sale is the index; its total for any period—a week, ten days, thirty days, six months — gauges the fluctuation. It tells the percentage of gains and losses by departments. These indicate the need of cause prescriptions that reach business building policies.

In this respect, there is no difference between a single line and a many-line store, so far as the management is concerned. In the former there are the same problems to be met and solved, only fewer of them. In the latter, each department is a store, and it is but necessary to treat these departments as individual stores to obtain the same result.

If there is any difference, it is this: the small merchant has the one final word when it comes to saying definitely what merchandise shall go on the shelves. The general manager of the big store is often the head merchandise man and must keep his hand

on the merchandise for all departments, indirectly through assistants. It is at this very point that the fluctuation in sales must guide him in whatever adjustments he makes.

Fluctuation in business makes it necessary for the general manager to keep track of daily sales; this can be done only by watching each department as a unit and adding for a total, to ascertain the general increase or decrease in trade.

Each morning at nine o'clock in one store, the general manager gets a daily department report that summarizes each of the fifty-five departments; the sales, say, for 1912 and 1913, the purchases for 1913, and the estimated stock for the same periods. This also gauges the merchandise purchased in comparison with the sales, the bills on file, the orders for the current month, the month ahead, and those for a longer period.

Sales form the background against which purchases are built. Merchandise may be bought for delivery at a certain time, and may be countermanded if the loss in sales is marked; or, of course, additional purchases may be made if the sales show a decided increase. The general manager must know each morning how far to go, because purchases are made daily.

This daily report starts with the sales check, which is either charge, cash, or C.O.D. It matters not which, for each must fulfill its function in the total. That function is to show the charge and cash business separate from the C.O.D., which is too hazardous to rely upon.

Sales checks reach the auditing department every hour of the day. If a charge or C.O.D. slip, it makes a slight detour by way of the inspector, shipping and credit departments. If a cash slip, it goes direct to the cashier by way of the inspector and then to the auditing department.

The cash sales check is sent with money through the tubes to the cashier. The customer receives a receipt and the salesman, simply as a protection, gets a voucher bearing the cashier's stamp.

The charge check is authorized by a representative of the credit department and by the inspector who transmits it to the auditing department.

The sales check clearly states the purchaser and his address, the department number, the article bought and the amount. It is essential for salesmen to make an accurate record of each sale. Failure to give correct data often creates confusion in the auditing department, which is responsible for the daily summary.

To avoid further confusion, the salesmen summarize their sales each day. These totals are given to the head of stock, who then figures all the sales in his department and turns the report over to the department buyer or assistant buyer. The buyer then forwards it to the head bookkeeper. He and the general manager alone know the total daily sales.

The daily sales report from the buyer to the auditing department is confirmed before it becomes official. The reports of sales checks and the summary are unofficial because they are subject to correction by the auditing department. After corrections are made, and any missing checks or dead C.O.D. slips traced by the auditing department, the report becomes official and is ready to form its part in the final department report to the general manager.

The department report is held until after the close of business each day to go with the final summary, which is given to the general manager in the morning. It is only an estimate, for the dead C.O.D. business, which often amounts to a thousand dollars or more in a big store, will not appear until a day or two later. It usually takes two or three days for this business to adjust itself. Then the general manager gets his final department report.

The sales report by departments would not give the general manager a sufficient basis for finding the cause of fluctuation in business and for ascertaining the net gains, if a strict watch were not kept on the current payroll. The absence of two salespersons in this department or that, lateness in arrival at the department, and so forth — these facts suggest incompetency or inefficiency, and might handicap the service to the extent that business in the end would show a heavy decrease. This, of course, is cared for by the superintendent.

Sales reports would also be less important as a barometer of trade if the cost of doing business for each week were not known.

Just as sales fix present and future purchases, so does the cost of doing business govern them. Therefore, the general manager gets each Saturday a report of all wages and all sales for the week. Each must have its own percentage of fixed expenses and the sales must bear a fixed ratio to the pay. But the daily department report is the real barometer of business. The daily report on department organization indicates the capacity to handle business. The report on individual salaries and sales determines the cost of handling it. The three must be considered together in order to read the store's profit.

Forty-eight hours after a tornado, a Nebraska clothier, who lost his stock in a fire following the storm, collected his insurance in full and had new goods on the way to the temporary place of business which he opened. Neighboring storekeepers labored with adjusters for days before getting their settlements; in more than one case it was impossible for them to establish their claims to anything like the damage they thought they had suffered.

The sales records of the fortunate merchant helped to secure this quick action from the insurance company. Sales records, although always maintained by the larger stores, are generally avoided by small dealers who have found cost prohibitive. A solution which makes them worth their keep has been developed by a Western dealer who carries a $50,000 clothing stock. His system is simple and inexpensive to maintain. With the changes individual conditions suggest it can be adapted to a store of any size.

The plan calls for daily and monthly sales records. This permits exhaustive analysis. Live lines may be distinguished from "stickers." Inquiries which lead to better business are suggested. Failures may be picked apart and successful plans may be intelligently followed to a satisfying conclusion. And profits put back into the business may be invested where they are certain to increase and multiply.

Daily sales cards lead the system for store billing. Sales for the day are divided as cash and credit items and listed by departments. Columns are provided for recording the cost of articles sold either on cash or credit. At the right of the card, daily store

totals are taken. At the end of the month the totals for departments are calculated and recorded at the bottom of the card. If a weekly balance is wanted, the sum of business done during that period is written in red in one of the spaces left vacant by Sunday.

Daily totals are taken from sales tickets. These are segregated by departments as they are received. Late in the afternoon, the amounts on the slips received are added by the bookkeeper. This partial list may then be completed in a few minutes after store closing. Consequently the manager has on his desk a complete record of the day's business before he starts home for the night. Or he can leave it to be analyzed in the first fresh hour of the morning, as he chooses.

Careful scrutiny of this card is one of his most important tasks. Falling off of business in one department may prompt him to the invention of new sales plans. Rush of business in another department may act as a reminder to prompt buying. The effect of business changes may be shown in another column. The day's work may be reviewed in the light of past performance. In all, the card is practically a daily written report from department heads.

In the form, a column for returned goods is omitted as it is the custom to deduct the sales value of goods returned from each department's total on the day's business. If such a plan is insufficient, a fourth column may be added alongside the charge sales under each department heading for handling returns.

Other features which may be added to the sales card with effect are advertising and weather columns. The advertising column shows the space and the mediums used for the day. These facts are useful in checking up the efficiency of advertising and assist the manager in analyzing and comparing past sales records. The weather column has a similar purpose. The letter " R " for rain serves without further analysis to explain the poor sales on a day which ought to have shown a good average of returns.

At the end of the month, the totals of the daily sales cards are transferred to the monthly sales sheet. This is the basic record of the storekeeper who operates on a knowledge of past performances. In making it up, the total sales, cash and credit, for each

department are carefully forwarded. Total costs are noted in the proper column, and from this data percentages are figured and a gross profit and per cent of gross profit obtained. Then expenses for the month are taken from the expense sheets and net profit and per cent of net profit for the month figured. At the end of the season or the half-year, figures for the period are totaled in the column at the right.

With slight alterations, the system outlined may be applied to smaller stores. For dealers carrying a stock of $10,000 or less, the permanent daily sales summary can be filled in according to the goods sold. Subdivisions of stock take the place of departments. In addition, the daily sheet with the day of the month given, but omitting the horizontal rulings, must be kept. This remains at the cash register and clerks enter sales on it as they make them. At the close of the day the figures are totaled and carried to the permanent daily record. The monthly sales record is similar to the form used by the larger stores. Departments, however, are omitted and sales are listed on the permanent daily record.

An Eastern retailer uses a system for recording sales which can be adapted to small store needs and also dovetailed into short-cut bookkeeping plans. When a sale is made, his clerk detaches the stub of the price ticket and places it in a box provided for that purpose. Every morning these stubs are collected and the number of sales marked in the proper columns on the card index.

The clerk enters the cost, selling price and lot number on the sales ticket, so it is a simple matter for the bookkeeper to follow in dollars the number of sales shown on the card index. Figures on the sales slips are carried to a combined cash book and journal and the totals are used in securing each day the daily gross profits. These daily totals are then transferred to monthly sheets. Charges and C.O.D. items are posted directly from a daily sales sheet to the journal, which carries columns for general accounts, customers' accounts and creditors' accounts. To save the bookkeeper the trouble of re-entering the individual items posted from the daily sales sheet, only the totals of these columns are transferred to ledger accounts.

The journal is ruled to economize work. The descriptive spaces are in the center, and to the left are columns which care for items to be posted to the general ledger. Green lines divide the debits from the credits; faint red and blue lines across the sheet enable the bookkeeper quickly to follow and locate place and line.

This division of the ledger entries into three parts affords a daily showing of amounts due on accounts payable (credit balance of creditors' ledger column), and amounts due on accounts receivable (debit balance of customers' accounts).

The debit balance of the cash column shows the cash balance in the house and in the bank, the balance of the latter item being carried on the check stub as cash. The separation of merchandise purchases and sales is carried to avoid the too common error of padding sales with merchandise returned to manufacturers, which, in the case of large items, is enough to disturb percentage calculations on profits and expenses.

The retailer who uses such a system need not depend upon the word of his assistants, or upon his memory, for details in any section or department. He has at hand, when he needs it, an up-to-the-hour picture of his store. Variations continually suggest themselves. The system is flexible enough to meet all conditions and is limited only by the ingenuity of the user.

XXX. Keeping Tab on Sales and Profits [1]

By W. J. Mullin

A Minnesota hardware dealer had just finished taking his annual inventory. After totaling the figures and casting up his liabilities, he found he had just about broken even on the year's business, instead of having the surplus which he had expected in view of the good trade experienced right along. He had started some years before, and had succeeded fairly well during the period when his business was small enough to be handled by himself and one clerk. As the town grew from a straggling village to a fair-sized city, however, competition, keeping pace with this growth, had resulted in a considerable lowering of the margin of profit. Sales

[1] *System*, September, 1913, pp. 290–293. Reprinted by permission of *System*. Illustrations of forms are omitted.

had increased tremendously; the annual volume ran over eighty thousand dollars.

The owner knew he was a fair manager, a good buyer, and while he had never taken the time or trouble to analyze his store problems closely, he had consoled himself with the thought that though he was selling on a close margin, the volume of trade was certainly making him money. To handle his increased business meant, of course, that expenses of all kinds had risen proportionately. While conservative, he made the mistake, so common among retailers, of not establishing a proper ratio between expense per cent and profit per cent. His last three inventories had not been satisfactory, but he had been able to cite various reasons to account for his poor showings. The inventory just taken, however, brought him to realize that a change must be made in the store if he was to keep it from going into the sheriff's charge. He must discover what was wrong, and remedy the faults without delay.

Taking counsel with the owner of a successful manufacturing business — a thoroughly live man and a close friend — he explained his situation and asked his advice. His friend had a keen sense of analysis, and, after looking over the books and stock, and asking a good many questions, he decided that the sales were either carrying a too heavy percentage of small profit lines, or that the general mark-up on stock was too low to make up for the expense incurred. Pointing this condition out, he advised putting in a record of sales and expenses by departments which would reveal the source of weakness.

A daily sales sheet was the first step in this direction. Six general classifications of the store's merchandise were made, which could later be amplified if more lines were added, or if it were at any time desirable further to divide the lines making up the six column headings. This latter contingency was not anticipated, however, as the schedule provided a fair separation of the goods in arriving at a comparison of sales, costs and profits for a store of this size.

It was also decided to add a column for the repair shop which was run in connection with the store — charging it with all materials and labor, and crediting it with the proceeds in sales.

Sales tickets were put into use both for charge and cash sales, and, as items were put down on the sales slip by the clerk, he also entered the cost in cipher from the price ticket attached to the article. Each morning the totals of both charge and cash sales were first cast up and entered in the column of total sales for the day. The costs were also totaled from the sales slips. The items were then thrown into the six general classifications of the store's merchandise, after which the amounts of sales and costs of each were set down under their respective headings on the daily sales sheet. This daily sales recapitulation looked good from the day it was started. As a natural sequence, the merchant soon found it advantageous to cast up his department sales and costs and the totals of his cash and credit sales at the end of each week in the blank date lines falling on Sundays. For the first time in his experience, the owner began to see what each department or general line in his store was doing day by day and week by week. Naturally he began to make comparisons, and in turn began to see the need for further records which would summarize results by months.

A monthly sales record was the outcome. This provided for entry of the totals of daily sales and costs of the different classes. Entry of gross amounts of charge and cash sales was carried merely as a memorandum on this monthly sheet — the segregation by departments not being of sufficient importance to warrant special columns by classes, either on this or the daily record. This was also true of returned goods, these not affecting the sales to an extent warranting their being a factor, as returned goods were principally exchanges, and entry on the stock record was usually sufficient. Having arrived at this point, rough figures could be struck showing ratios of costs and profits as between the general lines sold.

It was next necessary to analyze the various expense items in conducting the business, so that the resulting figures could show their related per cent basis to that of the profits realized from the goods sold. A daily expense sheet was adopted, therefore. Regardless of the fixed expenses, which were entered in the ledger, it was determined that for purposes of daily comparison,

every outlay, whether for salaries, express, postage or other expenses, would be grouped and set down in the proper column daily. Logically, a monthly expense summary followed the daily record. At the end of the month the sum of the various amounts paid out for daily expenses was set opposite the classifications on the monthly sheet.

Footing of the total of all expenses was then transferred to the monthly sales and recapitulation sheet, and set down with the other recapitulation items in the lower part of the sheet. Percentages of gross profit, expenses and net profit were figured, the resultant percentages showing comparisons on the business as a whole from month to month. The percentages as arrived at for the whole store were also applied to each of the six general classes of goods; these latter percentages being entered each month, in red ink, to the right of the segregated amounts.

A few months' use sufficed to show that the builder's hardware line, which had been counted a mainstay of the business, was not earning money; competition in bidding resulted in such low prices that this one line alone was lowering the profit percentage all over the store. When this became clear it was determined to fix prices in this department which in the future would bring the proper margin, or allow the other fellow to take the business.

Another discovery, made during the ensuing months, was that certain unprofitable staples were being pushed by the clerks at the sacrifice of sales on highly profitable specialties. To correct this tendency, the men were told that individual sales records would be kept in future and that the value of a man's sales would be reckoned from a profit-making standpoint rather than from large gross sales which carried too many staples. This resulted in the men taking more interest in the goods which required pushing, and while it meant some little falling off in the totals of individual sales for a time, the profit results were so satisfactory that the owner was content.

Going still further into details about the goods making up his stock, with the idea of eliminating unprofitable articles, as well as of securing an intelligent record of past sales as a guide to future purchases (also to afford protection against loss by fire

and theft), the hardware man determined to put in a perpetual stock record.

As the filling out of this record in full detail meant considerable work, the card was designed to account for only full packages of the numerous small items carried and sold every day — nails, screws, hinges and the like. For statistical purposes it was enough if the original packages were charged off the stock record immediately on being opened.

Larger articles, however, which meant heavy investment and demanded careful watching, such as tools, cutlery, paints, brushes, household utensils and other important articles making up the stock, were given cards which took care of both open and reserve stock. Certain articles which moved rapidly were given cards for each size, while in other cases one card showed the record for several sizes or descriptions — the column headings being so arranged that entries could be made either from top to bottom of card, or from left to right, according to the nature of the goods. Goods received were debited to the stock cards from the checked invoices, and credits for articles sold were entered from the daily sales tickets for the larger goods. Where bulk was broken, as in the case of the small stuff, a printed stock slip was made out and sent to the office, which was used to credit the stock.

In buying alone the stock record became almost as much a factor in the economy of the business as were the statistical records on sales and expenses, for the cards, with their graphic record of the movement of goods, saved many a dollar in investment over the old haphazard days of memory and faith buying.

After a year's use of his new records, the dealer again cast up results, and verified the story told him by the daily and monthly accounts he had maintained. The actual inventory taken, when compared with the perpetual stock record, showed a variation astonishingly low.

The net value of the stock in dollars and cents, as related to the more or less theoretical sales and profit figures carried on the statistical record, was highly satisfactory. The net profit percentage had steadily risen, while the expense percentage had not kept pace.

This guiding chart had pointed out the way to future prosperity. The merchant learned that to discover the difference between profit ratio and expense ratio another factor than the mere watchfulness over general outgo and income was necessary; the vital problem is analysis.

XXXI. The Danger Zone in Store Keeping [1]

By W. S. Zimmerman

"Take a $200 mark-down on that gold bag; reduce this bracelet $20." In the half-darkness which follows the closing hour on short winter days, the head of one of the largest specialty stores in this country walked by the counters of his jewelry department and directed new price levels that fell below cost. A group of buyers, following him by a few steps, noted with consternation the very radical reductions ordered by the head of the house.

"This jewelry department is thousands of dollars overbought," the merchant continued at the last counter. "It is a small retail store which has been mismanaged. The crudest of storekeeping blunders have been made. Only the fact that it happens to be under our roof keeps it solvent. Around the corner Brown or Smith would have failed miserably with it.

"On looking at things closely, I find that the initial mark-up is small for jewelry. Since the stock-turn is low with jewelry, we must cover some of the interest on the capital tied up here through an initial mark-up which is more liberal than usual. Some novelty lines we can mark up 100 per cent or more. The general run should not fall below 50 per cent.

"The salesforce is costing nearly 20 per cent of the sales, which is far too high. We must locate the best salespeople and speed them up until their wages are under 7 per cent of their individual sales. Then the slower sellers should be weeded out until the department's monthly payroll for salespeople is only 7 or 8 per cent of the jewelry sales for the average month.

"The turnover has not been over one or two — far below what we must have. Jewelry turns slowly, and a good deal of staple

[1] *System*, July, 1913, pp. 60–64. Reprinted by permission of *System*.

stock must be carried the year round. But here in the store, we should carry only enough staple stock to give 'tone' and meet current demands upon stock, and must put most of our selling effort on popular priced, quick turning specials. In this way, we can drive the turnover up to five or six times a year.

"I shall also stop all orders — no more stock is to come into the department until it is in a normal condition. Above all, in the future, estimates of jewelry sales are to be carefully analyzed. By this analysis you will find that a fairly constant percentage of the year's jewelry sales falls in each month. For instance, June with its weddings will carry a high percentage of the annual sales. So will December, the gift month. Once you have these averages, fix on a conservative volume for a year ahead and take out the percentages of the months that face you. Subtract these estimated sales from your stock on hand. Then buy according to the result.

"Now, I've read you fellows quite a lecture," laughed the merchant. "What I have said merely sums up the elements of good retailing. This store is just a collection of small stores under one roof and you must take into account all the points which the small-town jeweler would have to manage for himself."

This retailer has four thousand people on his payroll. He has established over a hundred little stores in the circle of his big organization. Still he says his problems and blunders are those of the smaller retailer. Furthermore, he adds that his experience in selling not far from a million dollars' worth of stock a month shows that these blunders can be avoided, and tells you how.

The buyer for this jewelry department, it later developed, was in a situation exactly like that of the country merchant who finally woke up and found that he had been too busy to make money — three-fourths of his work could be done by a five-dollar-a-week boy. The buyer had spent his days working out price ciphers and persuading manufacturers to create branded lines for his department. Instead, he should have estimated with care his probable sales, made sure that his expenses were reasonable, and planned for a profit-making stock-turn. Both the city buyer and the country retailer had been grappling with detail and had never

disentangled themselves far enough to size up correctly the things that really counted for progress and profits in their businesses.

Dead stock is a difficulty by no means peculiar to city stores. A Southerner had a few thousand dollars he wished to keep busy. He started a retail store and put a man in charge to "keep shop."

A year or so later a chance to sell out came, even though the store had not been making a great deal of money. The purchaser wanted an inventory taken. The man who had been "keeping shop" for the Southerner "guessed there was some ten thousand dollars' worth of stock on hand."

The actual inventory, the first in the history of the store, showed a stock on hand worth over seventeen thousand dollars. Seven thousand dollars had been buried on the shelves — just as thoroughly as if at the bottom of a well. Modern stock methods would have made the neglect of these goods impossible for more than a few months. Quick turnovers are only possible to retailers who know by effective records and correct stockkeeping methods the amount of goods normally demanded by their trade and the quantity on the shelves or in storage.

Analytic stock records not only automatically check stock and watch the mark-up, but usually also uncover valuable information regarding the best selling lines. If cards are ruled for each line of goods and every price noted for all items within the full lines, a girl can keep on them stock records which indicate the popular goods. The cards should separate the lines into departments and show daily receipts and sales of stock. The retailer who, by this economical system, can place his finger on his best selling line knows how to display and push and renew his stock to the very best advantage.

The credit man for a wholesale house stepped into the shop of a small Western retailer, under orders to investigate the little store's stock. He found goods on the shelves which his house no longer handled. The merchant was evidently at sea regarding his best selling lines.

"I'll bet you half your store that 50 per cent of your sales and 75 per cent of your profits are made on items you have

marked at fifty cents or under," the credit man finally said. He spoke from experience with the troubles of hundreds of small retail stores. "You're wrong," replied the merchant, "fifty cent lines do not give me half my volume. My big trade is in women's garments." The credit man took three days to investigate. He sorted the sales for a month by prices and in the end convinced the retailer that about 40 per cent of them were around half a dollar each. He next showed that, with proper buying, these sales alone could yield more than three-fourths of the store's profit.

The merchant took the information to heart. He installed duplicate sales slips as a check on the lines which turned quickly. He remodeled his store on a basis of small departments and specialized on those low priced lines which paid immediate profits. Working out the gains on individual lines enabled him to shift the departments which were losing money to more favorable locations in the store, or to discontinue them entirely without misgivings. He could also advertise departments with direct consideration of the possible profit in mind. At least he knew his business. Today he reckons a month's gross profits in figures which formerly would have seemed a satisfactory yearly record.

A student of retail methods with a liking for statistics has stated that three retailers in every four figure their profits inaccurately. They mark up by taking a percentage of their cost equal to the desired gross profit, instead of working back from a selling price.

Launching out into business, a young accountant ran into this error. He bought a half interest in a Pennsylvania retail store which showed satisfactory profits on paper. But when he went over costs and mark-ups with his partner, he discovered that most of the profits were imaginary.

His training enabled him to trace down the difficulty. He found that the dangerous trouble lay in his partner's system of estimating the cost of doing business as a certain percentage of the sales and then adding this percentage to the cost price when figuring for the selling basis on individual lines. The minute the new member of the firm used the desired selling figures as a starting point in marking, the business showed healthy profits.

The accountant correctly secured his gross profit (expenses were 20 per cent and the net profit desired 10 per cent) on an item costing ten dollars, by treating the selling price as 100 per cent and working the problem out as follows: —

Selling price, always taken as		100%	
Cost to do business	20%		
Net profit desired	10%		30%
Cost, $10 equals 70% of selling price			

Dividing the cost, $10, by .70, gave him the correct selling price: $14.28.

The partner had been incorrectly marking the same article at $13, or $1.28 below the gross profit he thought he was providing for, by calculating his selling price in this way: —

20% of $10 for cost to do business	$2.00
10% of $10 for net	1.00
Gross profit	$3.00
Cost	10.00
Selling price	$13.00

He figured his 30 per cent gross profit on the cost price, instead of on his desired selling price. But the cost was only 70 per cent of the selling price, which must always be taken as 100 per cent. Thirty per cent of 70 per cent gives 21 per cent, which is therefore the gross profit he actually secured. But he thought he was getting 30 per cent. Seventy per cent, his cost, plus 21 per cent, his actual gross profit, is 91 per cent, which is the percentage of the desired selling price he believed he was putting on his merchandise. Actually he was barely "making both ends meet" because of his incorrect method of mark-up.

XXXII. More Turnovers [1]

By Wheeler Sammons

Rapid turnovers are today securing the trade of a new five-story department store in a small Indiana city for a less pretentious shop diagonally across the street. Its quick turns allow the

[1] *System*, March, 1914, pp. 326–329. Reprinted by permission of *System*. Illustrations of charts are omitted.

smaller store, which is run by three brothers still in their thirties, to make money on margins so narrow that it repeatedly cuts under the prices set by the big rival's slow turnovers. The owners of the larger store, who bought their first stock in 1850, know bankruptcy is ahead if rising costs continue to mount into their dwindling profits. Bewildered for the first time in sixty years, they are fighting to save their sinking business. They have put in an accurate cost-keeping system, purchased new fixtures, and advertised heavily, still each January of the last three years has seen them meet deficits by reducing the savings set aside for their families.

The young brothers, also faced by rising costs, clearly understand why they are winning — they divide the high costs over many turns, a remedy for diminishing profits perfected since their older rivals learned to merchandise. These figures, which *System* took from the books of the two stores during last October, epitomize the situation: average stock, at cost, in the three brothers' ready-to-wear section, which sells annually clothes worth about $145,670 at wholesale, $14,481; corresponding facts from the big store — sales, $125,820; stock, $24,899. Since they are securing twice as many turnovers, the brothers make money on mark-ups which would not pay the larger store a cent.

"Quick sales at small profits is the modern idea," the elder of these three brothers says. "My brothers and I got our training under one of the most successful merchants in New England. Then we came West to try out his methods. We picked this city because the heaviest competition is controlled by two elderly men who learned the business in the days when the jobbers regularly gave six months' credit, and the retailers four or six. Theirs is the old idea — selling slow, at a good profit. We have in mind the Greek banana man who puts his money into fruit in the morning and has it back again by night, plus 2 or 3 per cent net profit. He makes over 600 per cent on his capital annually, if he is out every working day.

"We succeed in turning our money seven times a year now. I don't believe our rivals do better than three. We are quite satisfied with 5 per cent net on a turn — or 35 on our investment

in stock. They have to net over 11 per cent in order to equal our showing at the end of the year. We believe that it is better to get three sales at 5 per cent net, as long as you cover your costs, than it is to make one at 10. We build our big profit from a number of little profits — I think it's somewhat like carrying into merchandising a saying of Franklin's which father made me learn by heart: 'Five shillings turned is six, turned again is seven and three pence, and so on till it becomes a hundred pounds.'"

These ideas and methods are not unique. In practically every city and town some retailer or wholesaler is using them to overcome competition and master rising costs. In Logansport, Indiana, for example, H. S. Seyboid of the Seyboid Dry Goods Company cut $5,000 from his linoleum inventory and handled more sales. In Columbus, Indiana, A. R. Rosenbush reduced his hat stock over $800 and satisfactorily cared for his usual trade. Numerous like instances show that shrewd merchandising on small stocks is enabling distributors to pay rising costs profitably.

In much the same manner automatic machinery, new office appliances and scientific management have helped manufacturers and office men turn their capital quicker. When management finds a better way for handling men, money invested in wages yields higher returns; when an inventor perfects an office appliance that shortens tasks, again capital may be placed more advantageously; and when an automatic machine cuts factory work, the money spent for it gives larger dividends than resulted before the invention. More turnovers come from these advances, bringing new profits for meeting rising costs. Net gains nevertheless diminish in many industries because costs increase faster than the gross profits. Of course, the large sales volumes of today, when they proportionately lessen expenses, also make it possible for manufacturers and distributors to declare satisfactory dividends on lower net returns. But increasing the stock-turn, usually a far more adaptable means, realizes the same object — higher profits with no advance in price.

If, then, more turnovers is the business man's answer to rising costs, why have they been neglected? It is not difficult to

explain. More than ordinary knowledge is required to secure a rapid stock-turn and it has taken time for merchants to learn. Some got the knack quickly — our largest department stores, prospering on rapid turns at exceedingly narrow profit margins, resulted. The majority, however, saw no need for careful merchandising, since profits were long and costs low. But the rise in costs which marked the last ten years — over 3 per cent in retail lines — forced them either to learn or go out of business. When profits were generous, competition scattered, credits long, and transportation slow, it was safe, or even necessary, to buy a year or six months ahead. Today, following the rise in costs, margins are not generous enough to allow the holding of profits on the shelves in merchandise. The hand-to-mouth buying which results when failure is avoided demands a careful gauging of demand and a comprehensive stockkeeping system. Since these restrictions set no easy task, the commercial agencies tell us that 90 per cent of the retailers in America over-buy. Further, the reports of retail failures from the three causes which reflect the severity of the work — incompetence, neglect and inexperience — grow heavier: 33.3 per cent of all the bankruptcies in 1911, 36.8 in 1912.

This situation is of importance to all business, for it touches the profits of every enterprise. The happiness and prosperity of the homes are concerned, since over-the-counter prices must finally pay the cost of disasters in the factories and stores. To improve conditions enough to overcome the reduction in net profits, it is necessary that the merchants be given two types of assistance in their fight against rising costs and tightening competition — first, national standards against which to check their stock-turns; second, tested methods for speeding turnovers.

National stock-turn averages from over seven hundred American stores have been figured from *System's* investigations to give the averages for the ten standard types shown in Table I. From the books of several hundred stores carrying departmentized stocks averages for twelve standard lines were secured as shown in Table II.

TABLE I. THE TURNOVERS HERE AVERAGED ARE FOR THE COMPLETE STOCKS AND HAVE NO REFERENCE TO EITHER THE CHARACTER OR THE NUMBER OF THE LINES CARRIED

Type of Store	Average number of turnovers secured annually	Type of Store	Average number of turnovers secured annually
Grocery	10	Hardware	3.5
Department	7	Furniture	3
Variety Goods	6	Shoe	2.1
Drug	4.5	Clothing	2
Dry Goods	4	Jewelry	1.5

TABLE II. THESE AVERAGE TURNOVERS ARE FOR TYPICAL LINES AND BEAR NO RELATION TO THE TURNS NORMALLY SECURED THROUGH COMPLETE STORE STOCKS

Line	Average number of turnovers secured annually	Line	Average number of turnovers secured annually
Notions	9	Hosiery	4
Corsets	8	Gloves	3.5
Women's ready-to-wear	6	Dress goods	3.2
Wall paper	4.2	Silks	3.1
Men's furnishings	4.2	Domestics	3
Underwear	4.1	Carpets	1.5

With these averages to check against, retailers are in a position to decide if their stock-turns rank above or below the results secured in other stores. Turns are easily figured by dividing the sales for any period, at cost, by the cost of the average stock on hand during the period. Once he has secured turnover and cost figures for his store, it is not difficult for the retailer to demonstrate the added profit which an extra turn will bring. The net gains climb when the expenses are cut, the turnovers increased, the totals owing from customers reduced, or the gross profits lengthened. As soon as larger stocks accumulate, customers neglect to pay, or expenses increase, the net profits dwindle. To show these conditions, it is only necessary to express the customers' balances and the stocks as equal to so many average days' sales. Your sales, at cost, reach $360,000 a year, or $1,000 a day, let us suppose. Then, if your average stock costs $30,000, it equals thirty days' sales, and the total due from customers, fifteen days', if we take it as $15,000. Also, if your gross profit is 25 per cent and your cost of doing business 20, the net profit for the period will equal the difference between these two percentages

divided by the sum of the stock and the customers' accounts due, expressed in days, and multiplied by 360. Or, in figures:

Net profit on your capital for the year =

$$\frac{25 - 20}{30 + 15} \times 360, \text{ or } 40\%.$$

If the stock is increased to a sixty days' supply, the turnover lessens, and the net profit at once falls:

Net profit on your capital for the year =

$$\frac{25 - 20}{60 + 15} \times 360, \text{ or } 24\%.$$

But if you buy closer and push the goods on the shelves down to a fifteen days' stock, the increased turnover carries the net profit upward:

Net profit on your capital for the year =

$$\frac{25 - 20}{15 + 15} \times 360, \text{ or } 60\%.$$

Although these relations of profits to turnovers are universal, individual conditions vary the number of turns secured in specific stores. The standards given in this article therefore require modification when local influences are unusual. The turns secured in a large department and in a country general store will differ because of the heavy buying power touched by the city store and its managers' skill. The turnover averages given on the next page are from several large department stores and a score or more departmentized concerns in country districts:

There are variations as marked in the number of turns secured by stores selling single lines. The average turnover made by the groceries investigated was ten, but before competition tightened, John Harvey, vice-president of the Kansas Retailers' Association, handled sales averaging $100 a day with a two-thousand-dollar stock. Many a grocer is today carrying a stock equal to Mr. Harvey's for a fifty-dollar-a-day trade. Again, one of the largest concerns in Boston is making eighteen turns a year in its women's ready-to-wear sections — a Chicago store securing an equal volume of sales fails to make fourteen turns in the corresponding departments.

Stock	Number of turns secured annually: City department stores	Country general stores
Books	4	1.5
Candy	15	9
Clocks	2.5	1
Embroideries	3.5	3
Furs	5	3
Infants' clothing	5	3
Laces	4	2
Linens	3.5	2
Men's hats	7	4
Pianos	9	4
Ribbons	6	2
Stationery	5	2
Umbrellas and canes	11	3
Trunks	5	1.5
Veilings	5.5	2
Wash goods and flannels	5	3.2

Investigations among drug stores set 4.5 as the national annual turnover for the line. Nevertheless, there is one store in Chicago which makes a turnover every twenty business days, and another, a few blocks down the same street, counts seventy days to a turn. Naturally, stores in cities secure quicker turns than those near demands less dense, but expenses are usually lower outside of the urban sections. Even though they average similar variations, the standards here given enable retailers to check up their turns in a general way and specifically to place their stocks in relations with other lines. When the standards are studied in connection with the charts, which show turnovers and costs, it is possible to pick the lines that should rightfully pay the heaviest expenses.

With such average turnover records available, it is not difficult intelligently to try out methods used by others for speeding up stock-turns. Investigation of the merchandising plans successfully used by merchants in five states shows that they are getting more turns in four ways: locating lines which move rapidly; weeding out the slow lines; setting stock limits; concentrating purchases with a few manufacturers or wholesalers. Some of these merchants are using only one or two of these methods, others all of them, but not one has discovered and tested a fifth plan.

The first method for securing more turnovers — locating the lines which turn quickly — is, according to one of the most successful merchants in New England, at the foundation of good merchandising. Still President McGlasson of the National Wholesale Grocers' Association says that when he asks retailers merely how much stock they have, without reference to the turns secured by lines, many reply, "Oh, I don't know." Locating the fast turning lines only requires that stock be taken frequently and the inventories compared with sales recorded by lines. Once the fast turning, profitable lines are known, they are pushed and the stock on the shelves cut to the lowest limit. The quicker the stocks in these lines change, the more possible it is definitely to satisfy customers and operate on a small investment. Manufacturers frequently maintain in-stock departments for their fast turning lines, and thereby enable retailers to buy day-to-day supplies.

"We would not know where we were coming out if we didn't find the lines which turn quickly," declares a middle-western retailer who has made money out of hardware for thirty-two years. "Turnover and volume are in a way more important than profit — the success of R. H. Macy and Company in New York proves my statement. We — or anybody else, for that matter — could make money by selling everything on the shelves overnight for three-fourths of the cost, if the next morning we could buy at full price what we knew was wanted. The fast turning lines are the wanted lines. If you know them, you have the makings of a good merchandiser — and a good merchandiser will succeed, even if he is a poor buyer. We simply keep our sales and inventories by lines. It helps at inventory time if the retail prices are put on each invoice."

The second plan for increasing turnovers is to weed out the lines which move slowly. Once the fast turning stocks are tabulated, the less profitable lines immediately become evident. If these slow goods will not stand heavier mark-ups than the rapid lines, they are usually unworthy of shelf room. Eliminating unprofitable lines overcomes a cause of retail failure mentioned by 84 per cent of the successful merchants reached by the investi-

gation in four states — carrying too many lines. There are many lines which do not turn fast enough to warrant the retailer's investment, for depreciation gradually eats up the slender profit margins they offer. A huge sales volume might be built around these lines, and not a penny of net profit result. The stores which frequently go under when all is apparently prosperous are making this type of sales — their owners have not weeded out the slow lines.

A Kansas jeweler, who built a business given up by his father as worthless into a going concern netting him five thousand dollars a year, has definite views about this danger springing from slow turning lines. "If you don't know the weak lines, you're bound to hold stocks from season to season, and that's the shortest road to failure," he says. "It's all very well to have a bargain sale or call a job man or start a bargain store under your uncle's name, but it is much more profitable to know the stickers ahead of time. Then you can go easy on weak lines, or, if you do get caught, it is possible to persuade the clerks to help you with extra efforts, before it is necessary to take mark-downs.

"Don't stop at merely knowing the turns by lines, but know the goods. How many men who sell them every day know how clothespins are made? Close acquaintance with your stock will probably enable you to widen your appeal to customers by selecting new lines — and to do so brings new profits. When you get that sort of a grip on your stocks it's only a question of stock-keeping to weed out profitless lines. Once you get the rapid turning lines going well, you will be in a position to aim for big gross sales and less profit — that is the type of business which makes money. I sell a certain novelty pin, for instance, from a ten-dollar stock, by reordering daily. I don't invest more than twenty dollars at a time and I turn it twice a week at 3 per cent net on each turnover. My friend down the street sells at a 20 per cent net profit a farm implement which cost him one hundred dollars. It took him six months to make the sale. Against his 40 per cent — counting that he repeats the sale in a like time — I make 312 per cent and have eighty dollars less tied up. That eighty I put into other fast lines."

Third among the tested methods used by the merchants working in four states for rapid turns are definite stock limits and plans. The best way to prevent over-buying, in the opinion of these merchants, is to fix the lowest stock which will satisfy demand and then place orders accordingly. This, again, is a stockkeeping problem. Sales and purchases kept by lines give turnovers. From several years' records of turnovers, sales and purchases are estimated three, or even six, months ahead. A reasonable increase in sales is figured and leeway left so that attractive " snaps " may be purchased. It is then possible to hold the stock to limits fixed by weekly, monthly and semi-annual reports. The facts for these reports are taken directly from the sales slips and account books.

A system of this nature is maintained in the store of every one of the successful merchants whose methods were recently investigated by *System*. These stores have elaborate records, others only a cash book and a few cards for recording sales and inventories. They all, however, know limits beyond which it is unsafe to buy. This overcomes the constant temptation to buy for a discount, to let the stocks grow faster than the turns, or to allow the buying to get ahead of the selling. The investments in stocks are automatically held to profitable figures, the orders restricted to small quantities, and the fast turning lines pushed. In these stores new stock is arriving every day — fresh goods which the salesmen like to handle — and very little of the profit is on the shelves.

There is one danger in buying too close, however. An Iowa variety store owner, who averages eight turnovers a year, mentioned it specifically, although the majority of the merchants seen by *System's* investigators referred to it. " Your profits are in buying close," he said, " but you are tempted to cut down your assortments, and that costs trade. Butler Brothers, the wholesale house, tell me that all of the failures reported to them in my line during the last thirty-five years were caused either by too much stock or too few lines. So we are between fires. There is only one object, however — to get what the customers want, in the quantity they need, at prices they are willing to pay. I find

that a want book and a simple perpetual inventory increased the turns in one of my departments from one to four and a half. I keep four daily records — charge and cash sales by departments or divisions of merchandise; daily sales by clerks; money due from customers; and money owed by me and my bank balance — and six monthly records — clerks' wages and sales; charge and cash sales by departments or divisions of merchandise; net profits; expenses; inventories; and notes outstanding.

"But, after all, records are valueless unless you learn to say no, when you're properly stocked, to the type of salesman who talks about sales prospects, loads you up with more than you need, and then helps out your rival when you can't buy any more. My advice is to be as careful about the buying as you were the first year in business and to care for it yourself as long as your time is not exceedingly valuable doing something else."

The fourth method for securing more turnovers is to concentrate the buying with a few wholesalers or manufacturers. To do so is helpful in two specific ways. First, there is less danger to the retailer of over-buying through duplication, and bookkeeping troubles are reduced. Second, the manufacturer or wholesaler is naturally unusually interested in the retailers who buy heavily from him. Especially in lines where style changes are important, coöperation between the retailer and the manufacturer is valuable to both. The style points which the manufacturer is able to supply help to increase over-the-counter sales when passed on to the retail selling forces. Small stores are assisted in their buying, and guarded from over-stocking, by the manufacturers' or the wholesalers' salesmen, when the orders are large. On the other hand, most traveling salesmen attempt to overload the man who unnecessarily scatters his buying. Furthermore, the best "snaps," and the most favorable service, go to the retailer who has concentrated his buying.

Standards against which to check the times invested capital should turn and plans like these tested methods for handling stocks supply more turnovers — the business man's answer to mounting costs — not only to the retailer, but to all business. In office and factory the stocks are not usually retailed, still they

respond to improved methods for getting more from business investments. Standards for office work are being established, and turnover averages in some manufacturing industries are already known. Alex Legge, general manager of the International Harvester Company, has called the attention of his men to the increased turnover which will result from holding down the materials on hand, the goods on display, and the credits extended to customers. His immense organization is faced by increasing costs; so are most enterprises — the effects and results of efforts to meet these higher expenses will influence makers and distributors alike. When the retailer buys in smaller lots, wholesalers must ship with greater frequency. Manufacturers, in their turn, establish in-stock departments or supply the jobbers with smaller units. In other words, the broad answer to rising costs prescribes, first, strong coöperation between the makers and the distributors; second, an earnest spirit among enterprises to help one another make money yield larger returns through more turnovers.

CHAPTER IV

FACTORY STATISTICS

Introduction

Factory statistics, unlike statistics for the sales departments of manufacturers or wholesalers, are concerned with operations which are concentrated and which are more or less highly standardized. Effort expended in manufacturing yields results which can be measured more exactly and evaluated more readily than the results of sales efforts. Because of the greater standardization of the tasks and the concentration of processes, more detailed records can profitably be kept for the factory than for the sales department and the results can be more easily supervised.

As in the sales department, the factory records aim to show what is taking place, to reveal irregularities, and to provide information needed for the formulation of policies. A distinction is to be made between individual memoranda or reports and statistical records. Occasionally a factory has an elaborate system of individual reports or memoranda for each piece of work done, but has no statistics. The absence of statistics in such an instance is due to the failure to provide for the compilation of summaries and totals from the individual reports. If the data entered upon the individual reports are not tabulated in a form which permits of comparisons being made, the reports are not being fully utilized. The statistical records which are compiled from the individual reports may be of secondary importance, but they are nevertheless valuable. It is the utilization of these reports and records for statistical purposes in factory management with which we are concerned in this chapter.

In discussing these statistical records here, no sharp distinction is drawn between the different types of factory management. The manner in which the statistics will be utilized and even the sort of records which will be kept will depend, to be sure, upon the

type of management — upon whether or not there is a separate planning department, for instance. Nevertheless in all factories statistical records are necessary and the fundamental statistical principles involved are essentially the same.

The statistical system used in any particular factory depends, in the first place, upon the nature of the business — upon whether it is a continuous-process industry such as paper manufacturing and cotton manufacturing, an assembling industry such as automobile manufacturing, or a jobbing business such as that of a machine shop turning out chiefly special order work. Establishments of the third class obviously offer little opportunity for standardization and their statistical systems are highly individualized. In the first two classes of establishments, however, there is more or less standardization and the greater the standardization the simpler is the system of records and reports. The statistical system, finally, depends also upon the size of the establishment. A large establishment not only can afford to maintain an elaborate system of statistical records but the very magnitude of the business with its delegation of responsibilities necessitates a comprehensive and thorough-going system of checks and balances.

The selections reprinted in this chapter may be grouped under six headings — (1) purchasing and stores statistics, (2) labor statistics, (3) machine records, (4) records of progress of work, (5) records of shipments, and (6) cost statistics. Although most of these articles were not written from the statistical standpoint, they illustrate some of the statistical problems involved in keeping factory records.

Purchasing and Stores Statistics

Although the place of the purchasing department in the organization and the form of purchasing records to be kept depend upon the type of business, in all manufacturing establishments it is generally worth while to keep purchase records which at least show the total quantities of each of the important materials purchased. Such statistics are useful for purposes of comparison even where they are not utilized as guides for future purchases. In a machine shop purchases are made largely upon requisition,

according to the varying needs of the plant; consequently the purchasing agent in such an establishment has little discretion in determining the quantity to be ordered or the time of ordering and only a simple form of record is used.[1] In other businesses the purchasing agent frequently has occasion to utilize not only the records of previous purchases but also other statistical reports and records. In a cotton mill, for example, the purchasing of the raw material is commonly under the immediate direction of the treasurer, who is the chief executive officer of the company, and, when the market conditions seem to make such a course advisable, raw cotton is often bought in large quantities in advance of the needs of the mill. The cotton mill treasurer, therefore, finds it necessary to follow closely statistical reports of crop conditions, prices, raw cotton movement, and stocks available in the various markets.

In the prices of some materials, agricultural products and others, there are seasonal fluctuations, and a knowledge of these fluctuations, determined by occasional statistical investigations of prices paid or of quotations received, enables a purchasing agent to regulate his purchases so as to take advantage of the seasonal swing.

In the stores department of a manufacturing establishment it is a common practice to keep a perpetual inventory for each material and for all supplies. From such a record it is possible to ascertain not only the quantity on hand at any time but also the quantity received and the quantity used — statistics which have high value for purposes of comparison. These figures, together with a record of materials on order (ordered but not delivered) and a knowledge of the time required for securing the delivery of fresh supplies, are also utilized statistically in establishing maximum and minimum stores limits for the guidance of the stores clerk or the purchasing agent.

Labor Statistics

Under labor statistics the first item is the record of production by each laborer and by each group of laborers. These records are

[1] One form of purchase record was shown on page 10.

to be compared with standards which have been established either through time studies or other special investigation or from a statistical tabulation of past records. The methods of working out standards from time studies and from past records has previously been explained (pages 26–27).

In some factories, in order to detect waste, a record is kept of the materials used by each workman. In a shoe factory, for instance, a record may be kept of the number of soles cut from a given quantity of sole leather by each cutter, with an entry of any gain or loss over the estimated yield of the material. The daily figures for net gain or loss are combined in the form of cumulative records which afford an excellent check upon the workman. In a machine shop a record may be kept to show the quantity of work spoiled by each workman, or in a weaving department of a textile mill a record of the quantity of second-grade cloth woven. From these individual records totals may be computed which provide valuable checks.

Payroll records, in addition to their primary use for accounting purposes, are occasionally utilized in connection with records of production as a source of information to aid in changing from a system of time wages to a system of piece-rates. The payroll shows what the earnings have been for each class of workmen and, if the system of remuneration is changed, the piece-rates are adjusted so that the workmen will earn at least as much as previously, provided the same rate of production is maintained. The payroll figures for individual employees are sometimes followed regularly to ascertain whether or not earnings under a piece-rate system are increasing or falling off. If any workmen show a continued falling off, it is generally a sign of trouble and may lead to discontent on the part of the employees. By detecting the decline before it is too late, the manager may be able to remedy the difficulty.

Recently manufacturers have begun to give attention to what is called the "labor turnover," or the frequency of change in the personnel of the working force. Oftentimes an unhealthy state of affairs has been revealed — a rapidly changing labor force and a large number of men hired to maintain or slightly increase the

total number employed. The term "turnover" is suggestive but in its application to employment it has never been exactly defined and obviously cannot be used in the same sense in which it is applied to stock-turn. Owing to the danger of confusion with the usage of the term for other purposes, it does not seem advisable to attempt to formulate a standard definition and that is not necessary for practical purposes since the desired results can be presented without such definition.

There are two distinct but closely related ideas involved in the discussion of this topic: the first is the comparison of the number of persons hired with the net increase or decrease in the number employed and the second is the ratio of the number of new employees to the number of permanent employees. If the total number of employees in a given plant is 1200 at the beginning of the month and 1500 at the end of the month but 600 new employees have been hired, it has been necessary to hire two men on the average for each position filled during the month. A record which shows this fact affords a valuable check upon the employment manager since it indicates the care with which employees are selected. The record should be planned, therefore, to show the number of employees on the payroll at the beginning of each month, the number leaving during the month, the number hired, and the number on the payroll at the end of the month.[1] From these monthly records annual totals can be compiled. At the end of the year a record may also be compiled to show the total number on the payroll and the number who have been in the employment of the company for the entire year. From these figures the ratio of veterans to recruits can be determined, a ratio of significance in many plants since if the ratio of veterans is low it indicates improper selection, dissatisfaction, or internal friction. These same methods are applicable, of course, in department stores or in other establishments employing large numbers of persons.

Machine Records

For machine performance, records are kept to show the production by each machine and, if the machine is in operation only part

[1] In some establishments a weekly record of this sort may be preferred.

of the total operating time of the factory, the number of hours operated. These figures may be compared with established standards. They are also useful for cost accounting purposes.

Records of Progress of Work

The individual records for materials, workmen, and machines are totaled by departments to show the amount of work performed in each department and to check up results. If a schedule is used, reports are also required to show the progress of work. At all points where it is possible for partially manufactured stock to accumulate, records should be kept to show daily or weekly the quantity on hand. This aids in preventing a dearth at one place or a congestion at another. In a properly balanced plant these accumulations are reduced to a minimum, but they need to be checked constantly. In the stockroom, where finished goods are stored, records are obviously necessary in order to provide essential information to the sales department as well as to the general management. The stock records in a manufacturing plant with a diversified output which may be carried in stock are similar to the stock records kept in a wholesale house.

Records of Shipments

In the shipping department classified records of shipments are kept. Another set of statistics, which is less common but none the less valuable, is for delinquent deliveries, and in some factories these figures are most readily kept in the shipping department. They show the number and value of all unfilled orders which have not been delivered upon the promised date. Punctuality in delivery is an important means of maintaining good will. A manufacturer with a reputation for punctuality in delivery secures many an order over a competitor who offers a lower price but who has a reputation for delinquency in making deliveries. This is an item well worth watching constantly, and a statistical record best serves this purpose.

Cost Statistics

Cost statistics are closely related to the other factory statistics. It is this relation which it is intended to bring out here, without entering upon a discussion of the accounting aspects of these figures. The selections on this subject are intended merely to indicate the statistical problems involved in the selection of units, and the records which are needed as a basis for the determination of rates. If a machine-hour rate is to be established, for example, it is necessary to know the normal number of hours which each machine is in operation, and this is ascertained from past records.

I. The Purchasing Agent [1]

By Elihu C. Church

Purchasing has generally been considered merely in the narrow sense of giving a man a requisition and then requiring him to buy the material called for, for as little money as possible. This is doing a " commission house " business in its narrowest sense, and can in no way effect the desired results. Correct purchasing is not merely a matter of " buying." The buying has but little to do with the real economy and efficiency of the undertaking. The work of the purchasing agent should begin before the requisition is drawn, and should continue after the goods have been bought, delivered and inspected. He should see that the goods are properly stored and issued, that they are put to the use intended, that they are used efficiently, and that they are kept in service till worn out.

The purchasing problem is the most interesting and the most important subject before American business men. It not only largely governs the economy of all their expenditures except rent and payroll, but it should also control their selling policies. Goods are only sold because some one wants to buy; the customer's purchasing problems determine the manufacturer's selling problems. To sell properly one must meet the requirements of

[1] *Engineering Magazine*, June, 1915, pp. 420–421. Reprinted by permission of *Engineering Magazine*.

those who buy. To talk of a sales policy except in terms of the purchaser's buying policy is foolish.

It is only when the full scope of the problem is considered that the opportunities for savings and improvements can be realized. Strange as it may seem, the actual prices paid for supplies and materials are not of so much importance. It is necessary to explain so revolutionary a statement, for generally price is about the only thing considered worthy of attention, and a difference of but a few per cent between two bids will swing the order from one seller to the other.

In the first place much unnecessary material is bought. While a purchasing agent is haggling over some slight difference in price he may be unaware that the supplies he is bargaining for are quite unnecessary, in fact that there are already plenty on hand. This will often happen where improper storeroom methods and the absence of the necessary records fail to reveal the conditions.

Again too expensive supplies are often ordered. Perhaps while all the attention of the agent is being given to this small difference in price it may be that the man ordering the supplies in question specified qualities and grades superior to the requirements of the work to be done. Without standard specifications based on the actual conditions to be met it is easy to buy materials that cost double what is necessary.

Many requisitions are excessive in amount. The purchaser may not realize that carelessness in the estimating department has resulted in ordering an excess of material. Buying even a little extra material which is not needed and will not be used may offset the most painstaking price-saving ten to one.

Market conditions are often ignored. Perhaps when supplies are bought they are bought as cheaply as possible, yet it frequently happens that lack of forethought makes it necessary to go into the market when conditions are unfavorable and prices high — just because no proper attempt had been made to estimate the future requirements of the business and plan a purchasing campaign to extend over a considerable period of time, and thus take full advantage of the various fluctuations and changes in trade conditions. What is a low price if forced to purchase at

once might really be a high price when compared to the figure that might have been obtained if the necessity for making the purchase could have been foreseen.

The best purchasing economies are rendered of no avail by a careless inspection of the goods actually delivered. An infinitesimal difference in price between competitors is instantly apparent on the bid sheet, but vital differences in the value of their respective deliveries might remain undiscovered unless there be a careful and systematic inspection of all goods bought. Superficial examination and a mere counting and weighing will not suffice.

Poor methods of stores control are frequent. Improper care of supplies, and careless methods of storage and issue lead to losses from deterioration, waste and theft that counterbalance the possible savings due to careful purchasing many times over. An improperly conducted storeroom is capable of producing greater and more different kinds of loss and annoyance than any other one spot.

Frequently supplies are not put to the use for which they were intended. High grade materials are invariably issued by careless men in charge of supplies if the cheaper article called for is not in stock or convenient to get at. The difference in price between the material actually used and the material that would have served the purpose is a clear loss.

If supplies are not used efficiently and economically the quantities requisitioned will be excessive. This excess is an absolute loss; it is a direct loss; and it is generally a great loss. For instance, if a boiler room is so managed that the coal produces only 80 per cent of the steam that it should—it simply means that the coal bill is 25 per cent greater than necessary. Similarly for all supplies. It is "straining at a gnat and swallowing a camel" to direct all one's attention to the price of the material purchased, and then permit it to be used inefficiently.

Goods should be taken care of and used as long as possible. It should be apparent that the value remaining in an article which is discarded or replaced before being worn out is practically all lost. If a tool or machine capable of rendering a certain number of units of service be cast aside when it is four-fifths worn out the

loss of the remainder is equivalent to adding one-quarter to its original cost. A purchasing agent can seldom effect a price reduction of anything like this amount, yet a careful use of equipment, a proper policy of maintenance and upkeep, a habit of taking care of one's things and making minor repairs when necessary, may double or treble the life of one's plant.

The philosophy of correct purchasing consists in getting the right materials, in proper quantities, at a low price, and with as little cost for the doing of it as possible. But the fact must be emphasized that purchasing is but one part of the larger problem of stores control. No matter how well the mere purchasing function is carried out the losses due to improper methods of drawing requisitions, and to unscientific inspection, storage, issue and use of supplies may more than offset all the savings in power plant, factory and office.

II. Anticipating Buying Emergencies [1]

By H. A. Russell

There are frequently times when the question of price is an insignificant factor, as compared with the need of securing the desired material, supplies, equipment or repair parts of some machine that has broken down in the midst of a rush period. The question of whether to have a heavy shipment come forward by express or freight can usually be decided in a few minutes. The important item is to know the one best and quickest method of securing the article needed. The purchasing department must look ahead, not only of the requirements of the factory, but also of the prospective orders which the sales department is endeavoring to secure. The greater the problem of obtaining satisfactory deliveries, the more evident will become the efficiency or non-efficiency of the purchasing department. Six months ago was none too soon to prepare for the present congested condition of the steel mills.

First, let us consider the question of anticipating the requirements of materials which later become a part of the finished

[1] *Iron Age*, December 2, 1915, pp. 1300–1302. Reprinted by permission of *Iron Age*. Illustrations of forms are omitted.

product. If the product consists of standard lines, placed on the market from year to year, the purchase records should clearly and accurately indicate the variations in price from time to time, the quantity used during a season or year, the standard quality used and possible substitutes, the list of sellers of each item from whom purchases have actually been made and a further list of sellers from whom the same items can be obtained. With such records the buyer has a solid foundation on which to build up his purchase program for the period ahead, and it matters very little whether the period is to be of six months or longer duration.

Supposing that after the buyer has taken every precaution to have the materials coming along, as the factory needs may demand, and through some cause, beyond the control of the seller, shipment will be considerably delayed. Does the buyer then throw up his hands and pass the information along to the production department, or does he get busy and secure the material elsewhere? It depends to a great extent on the amount of precautionary work that has been done beforehand.

We all know that there are certain items for which no reasonable substitutes are available, but is it not a fact that the proportion of these items is comparatively small? And is it not also a fact that even this proportion can be considerably reduced, if we keep our eyes open and constantly try out and experiment with new things? In our product we use a number of sections. To secure a few tons of any of these may take many months. When our order is sent in to the mill it is entered and held until sufficient tonnage has been received, from other sources, to justify a rolling. Usually this procedure is satisfactory because we have anticipated our requirements. Supposing, however, that the rolling was delayed longer than usual and it was necessary for us to secure this material or lose a number of orders. Our first step in an instance of this kind would be to look over the list of possible substitutes and get in touch with the makers, with as little delay as possible, and in the majority of instances we have been able to secure the substitute section in time for the factory needs. The question of cost does not enter into the matter as much as the question of whether the substitute section will give as good service as the one it replaces.

Now let us consider the proposition of making use of the many large stocks of steel bars, angles, channels, sheets and plates, etc., that are carried in all the larger cities, and any item of which can be usually shipped the same day up to varying limits of tonnage. Almost all of the warehouses issue monthly stock lists and these, when received, should be properly filed so that they are instantly accessible. As the latest issue comes to hand, the previous copy must be destroyed; otherwise reference may be made to what will then be an incorrect list and valuable time may be lost. Where the lengths carried in the warehouses are at all suitable for the requirements, delay will be avoided by specifying these stock lengths. At times when the stock lengths will cause too much waste, as in the instance of large sizes of I-beams, channels, etc., the best plan is to specify the exact length, and as these sections are generally carried in various lengths, from a few feet up to forty feet or even fifty feet long, the small quantity ordered can be cut from the longer pieces and still leave a desirable length on hand. As the warehouse price, at the present date, is from one-half cent to almost one cent per pound (including freight, which of course must be added to arrive at a true figure) higher than prevailing contracts, the quantities ordered from stock houses should be based, as closely as possible, on the amount of tonnage required to keep factory orders on the move, until a further supply of that particular size will be received from the mill.

When an inquiry is received for certain machines, which are not a part of the standard line, and the space of time allowed for shipment would not permit of securing the material from your regular mill, your quotation should be based on warehouse prices. Under present conditions it is extremely unlikely that your competitors will be able to secure the desired materials any sooner than you can.

As I have remarked before, the factory stockrooms should be under the control of the purchasing department, working in conjunction with the production department. The stocks of the various items should be governed by a low and high limit for each item. These limits are to be set by the purchasing department and can only be changed by its instructions. When materials

and supplies are readily obtainable and deliveries are prompt, the high limits can be reduced; when the securing of these items is a question of weeks, instead of days, the limit must be raised. These limits should be changed only upon written instructions being received from the purchasing department. Our usual method of notifying the stockroom keepers of a change is to send them a typewritten memorandum, somewhat as follows: "Until further notice, reduce (or raise) the low (or high) limits on carriage and machine bolts 20 per cent." To the man in charge of the stock of steel bars, slabs, etc., and the sizes of which are used for so many different machines that we carry the different items on a low limit basis, we send each week a list comprising about thirty of the leading sizes and then receive his report of the quantities on hand. In the office we record this information as received and by comparing the quantities on hand with the low limits that have been set, we are enabled to have a complete grasp on this stock. As soon as the stock on hand of any of these items falls below the limit that has been set we refer to the card which shows the quantities of each item specified with the mill, and hurry up shipment of such items as are necessary. These low limits are changed also as conditions necessitate.

This perpetual inventory of stock on hand and list of orders placed and material en route is kept in the purchasing department, and consequently the responsibility of keeping the stock ahead of requirements rests there also. In keeping the perpetual weekly inventory, the top figure in each section indicates the quantity on hand in net tons, the second figure indicates the tonnage shipped but not yet received, or if in a car on the switch not yet unloaded, and the third figure indicates the total tonnage of the item ordered from the several mills and unshipped. The amount of the tonnage specified of each of these items, also the order number, date and seller are also recorded, and the extreme right-hand column of each section provides a place to indicate the date the item was shipped. We have not provided a space to note the promise of shipment, as we preferred to note this on the copy of the order. We divide the tonnage of the different sizes between the mills. We have found it advan-

tageous to do so, for the reason that often one of the mills will have a rolling of a size about the time that we need the material. As a proof that it pays well to watch each item carefully, I would instance our own particular case. Several years ago, when mill deliveries were from three to six months behind orders and our total tonnage for the year was over 2000 tons, it was only necessary to order from the different stock houses a total of less than 20 tons, or less than 1 per cent of the requirements. Furthermore, no shipments of customers' orders were delayed, nor was the factory held up at any point in getting out the maximum output. Of course daily consultation with the departmental foremen was a necessary part of the routine. It might be well to state here that these consultations are usually handled by the production department, who, in a brief summary, report to the purchasing department.

Where the product is practically uniform from year to year and the estimated sales for the year ahead can be based on the sales for the previous years, taken in conjunction with the outlook for the coming period, it is only a matter of detail to work out the quantities of all the materials needed to manufacture the required number of machines. Here the buyer has a great opportunity to tie up a large amount of non-producing capital, unless he is familiar with the selling season for each group of machines. It is very easy to order many items which may not be needed for months ahead, and the amount of money involved could be earning at least the average banking rate of interest, even providing it could not be used to better advantage elsewhere. Besides if the material is received too far in advance of actual needs it will take up storage room which could be used for other quicker moving items. Only by exercising his best judgment may the buyer satisfy himself that it is wiser to order materials a considerable length of time ahead of requirements, in order to take advantage of a low-priced contract that is about to expire.

A card shows the method of keeping the boiler stock up to the low limits, which in this instance are set by the sales, purchasing and production departments, working in unison. The figures in the second column indicate the quantity of boilers of each

size and style which are to be carried on hand over and above active customers' orders. These low limits do not, in all instances, indicate finished boilers ready to ship but rather the number of finished boilers, plus the boilers partly finished, plus the quantity of plate on hand from which each size and style can be later constructed.

The figures in the remaining columns show the stock on hand, finished and partly finished and plate, at each of the dates shown at the top of the columns. This card gives an instantaneous reference, not only for the stock on hand, but also the number of each size and style sold in a given period. If the figures do not indicate a rapid movement of any particular size, the low limits can be reduced. However, if they indicate a movement above normal the limits are raised, to be advanced further if necessary. As will readily be seen the record can never be more than a week behind the actual facts. For the purpose of keeping these two perpetual inventories, steel bars and boilers, we use a card measuring 5 x 14-in. A card of this size, while special, affords a comparison for a much longer period than the usual standard 5 x 8-in. card. In fact we use these 5 x 14-in. cards for a variety of purposes, such as recording the amount and cost of electric power and light used monthly and yearly, the amount and cost of coal, pig iron and scrap, purchased yearly, etc. The greater the quantity of these records the buyer has at his command the more intelligently can he foresee the needs of the plant.

At times quick action is needed to secure a repair part for some machine that has broken down in the middle of a busy season. While certain important parts of the larger machines are carried in reserve, it is hardly possible to carry a duplicate stock of all the parts that may break. When we purchase new equipment a most complete record is made of each machine; the seller's name and address, the maker's shop number and the size and style of the machine, a list of all the loose parts which are regular or special, the date and number of the invoice, the purchase order number and the maker's factory order number, if given. All these are a part of the record. It is advisable to have the factory address also. It may very well happen that if this information is at hand,

a considerable delay can be avoided in securing the duplicate parts. For instance, if a breakdown occurs late in the afternoon a telegram can be sent at once if the purchase record is complete, and shipment of the parts can usually be made the same day, but if valuable time must be wasted in locating the original order or the invoice the telegram will reach its destination too late to permit of shipment being made until the following day. A large percentage of machines are sold through agencies or branch offices located many miles from the factory, so it can readily be seen that the items of factory address and order number are of real importance. Often the foreman is undecided whether to have the operator report for work in the morning or lay off until word is sent to him that the machine is ready for use again. A request for a reply to the telegram or a long-distance telephone call will generally settle this point. In any event the first definite information should be passed along without delay, not only to the foreman but to the production department as well.

Another emergency that often confronts the buyer is the purchase of a new line, possibly the result of a recent invention, or it may be a product which has been upon the market for a number of years, but up to the time the emergency arises the buyer has not been called upon to add it to his list of purchases. To be prepared to handle these promptly and intelligently the file of *Buyers' Guides*, *Commercial Registers*, etc., should be complete and up to date. Circulars, clippings and memoranda should be carefully filed and, where necessary, indexed, if they in any way refer to products which are then, or may become later, a corporate part of the manufactured lines.

III. Checking Losses in the Storeroom [1]

By Wilford G. Astle

The balance-of-stores system of issuing, handling and accounting for raw materials may at first seem overwhelming to the managers of small concerns, who may consider it too elaborate for their needs. It is well to remember, however, that the broad general

[1] *Iron Trade Review*, January 27, 1916, pp. 235–239. Reprinted by permission of *Iron Trade Review*. Illustrations of several forms are omitted.

principles of a balance-of-stores system can be applied to a business of any size, as are the principles of double-entry bookkeeping. The late Frederick W. Taylor, who was probably the first man to study and work out the details of this system, laid great stress on the importance of the proper handling of stores; in fact, the efficiency engineer, when he is called in to direct a fight against waste and inefficient methods, usually attacks first the stores problem, which constitutes one of the greatest sources of loss. If an employee walked into the office, picked up a 50-cent piece, and put it in his pocket, he would promptly be discharged. In the storeroom, however, the careless handling, loss and even pilfering of material worth many times such a sum, is mildly deplored, but nevertheless considered a part of the game.

The usual storeroom losses can be classified as follows:

Loss due to carrying larger quantities of supplies than required; loss in delaying work or holding up the workmen; loss due to wasteful methods in the plant, and loss due to wasteful use of material, resulting from wrong methods of issuing and accounting.

The balance-of-stores system, when properly installed, becomes an important adjunct to the purchasing department, because the stores records can be used to answer the purpose of price cards and also take the place of the purchasing records as in the cases of firms or persons receiving orders.

Types of Organization

Three distinct types of organization exist at present among manufacturing enterprises. One of them is the old disorganized factory which has just " grown up." In it you will find the storeroom without any special system of control. The second is the factory which has discovered many wastes due to its unorganized condition and has taken means to check them. In this type of factory the storerooms are carefully looked after, separate departments and office force being provided for, and the authority of the persons in control of accounting and purchasing is clearly defined in relation to the stores department. All material is carefully classified, definitely located and guarded by a proper system of requisitions, records and inventories. The third type includes

firms which have adopted the scientific management system. In this type we will find that the material is not only guarded by systematic accounting, but a special clerk is provided to keep a balance-of-stores record. This clerk, being located in the planning office from which come all orders pertaining to stores, can tell at any time, by means of his records and location chart, the status of any material and where it can be found.

In addition to systematized method, modern management requires that not only the material for the manufactured product, but all materials and supplies used in the plant, shall be controlled by the authority of the department of general stores. It is, moreover, not sufficient, under scientific management, to send a requisition to the stores for needed material. All orders which require material must go through the balance-of-stores clerk's hands before they are honored. He examines all items and assigns them to a specific order, after which these items of material are not available for another order which may follow. This is done before the materials are required for use, and serves as an advance notice to the stores clerk of any unexpected demand for a particular material. This makes it possible to renew supplies on short notice. The planning department plans out the movement of the material from the stores department to any particular place where it is needed, also providing for the return of material as partly finished or finished product.

It is sometimes desirable, in the installation of a system of this nature, to carry stock for the ledgers in groups. For instance, one group would include all staples and another group would include all goods purchased for a particular purpose or job. Such material has usually been handled by a direct requisition on the purchasing agent, from the department requiring it. The goods are delivered immediately to the person or department issuing the requisition. This procedure might seem to be logical and expedient, but in a great many instances it has caused much confusion and dissatisfaction because the man on the job receiving the goods is not concerned with the proper accounting for the material, his duty being merely to use it to the best advantage. Again, material has often been purchased outside, which could have been secured from

stock. Critics may point out that vigilance in this case devolves on the purchasing agent and the storekeeper; but when a concern is carrying hundreds of thousands of dollars worth of material, storeroom records, not being considered as part of any regular stores-record system, cannot and should not be expected to prove infallible. Nor can the storekeeper keep mental notes of everything on his shelves. In any system where an attempt is made to keep cost and statistical records, it is much more simple to do so where all supplies are handled through one source and by one method. Quite as much bookkeeping and clerical work are required in cases where two schemes involving considerable duplication are in practice, one for stores materials, the other for supplies not passing through the stores, as are demanded where one method is used for keeping track of both.

Before explaining the balance-of-stores system in detail, it might be well to examine the basis upon which the standards of maximum and minimum quantities are established. The minimum basis for general stores is the length of time necessary to replenish the stock from the market. If it requires a month after the purchase order has been issued, to get the material into the stores, then the minimum amount of any item must be sufficient to supply the factory for that period of time, at least.

The minimum basis for finished stores will depend upon the probable shipping orders at the various times of the year estimated from past records, upon the time necessary to get various items into stores from the market, and upon the time needed to complete the process of manufacture for a new stock. A minimum stores amount is in effect an insurance against the losses which may occur when sales orders cannot be met on time. A failure in a firm's ability to deliver goods on time leads not only to cancellation of orders, but to a disorganized salesforce and a skeptical market. When stores have been reduced to the minimum quantity, a danger point has been reached.

The maximum quantity for stores is a somewhat arbitrary factor, but the essentials to be considered are the fluctuations in the demand during the seasonal periods. For example, consider the months of September, October, November and December as

one period. Suppose that during this period the average monthly sales are 1,000 units, but that the demand for October in some seasons may increase to 1,500 or more, while November may run as low as 500. If we count on an average run of 1,000 per month, the finished stores on hand will run high during November. This surplus, however, will be absorbed during the next month. Thus we can estimate our maximum quantity at 1,500. A safer limit probably would be 2,000, since October's demand may exceed the 1,500 mark, and it is not advisable to cut into the minimum reserve, if it can be avoided.

Just as the minimum supply is a lower limit to insure against the possibilities of running too low, so the maximum quantity is a higher limit to insure against the overproduction of stock and the danger of running too high. In making up a schedule of maximum and minimum quantities, many variable factors must be kept in mind. Perhaps a plant may be capable of turning out 2,000 units per month, but this amount may not be the most economical quantity to be handled. This last feature may result in the modification of the maximum amount, since the loss due to carrying a greater number of pieces would be more than counterbalanced by the savings made in manufacturing the product in economical quantities. The same reasoning holds good for the general stores maximum. Buying material in certain quantities may be more economical than the savings made in carrying small amounts.

The record for material is as essential as a ledger is for accounting, and it is just as important to know what your material balance is as to know your bank balance. Figure 1 shows a form suitable for a general stores record, which also constitutes a perpetual inventory. At the top of the form is the description of the article of which the record is kept. The accounting section includes four sets of columns. The first set deals with the number of pieces ordered through the purchasing department; the second set of columns are filled out from the receiving department's memoranda of receipts and the stores requisition slips, while the third set forms a record of material reserved for production orders, which causes a draft on the stock of material. Reservation entries

BALANCE OF CLASSIFIED STORES. Description of Article.											When quantity available falls to...................... issue requisition for					Symbol.	
Column 1. Stores ordered but not yet delivered.						Column 2. Stores on hand in the storeroom.					Column 3. Stores apportioned to an order but not yet issued.				Column 4. Stores available.		
	Date ord'd.	No. of pieces or quantity	Date rec'd.	Purchase order No.	Date to be delivered	Date rec'd.	No. of pieces or quantity	Date issued	Issued for Order No.	Purchase Order No.	Date apportioned.	No. of pieces or quantity	Date Issued	Order No.	Date	No. of pieces or quantity	Remarks

NOTE:- When stores are ordered, add the quantity to columns 1 and 4. When stores arrive, subtract the quantity received from column 1 and add to the quantity received to column 2. When stores are apportioned, subtract quantity from column 4, and add quantity apportioned to column 3. When stores are issued, subtract quantity from columns 2 and 3. In all cases bring down at once balance on hand in each column affected.

FIG. 1. Form used for Balance-of-Stores Record.

are made from the stores department's copy of each production order. The fourth set of columns shows the balance on hand in the storeroom, after deducting material in reserve for use on production orders already issued, but for which the material has not yet been taken from the storeroom. Actual count of material should be made as often as possible by the storeroom attendants, in order to check up the records.

Each day the balance-of-stores clerk prepares a list of material to be inventoried. The clerk from the balance-of-stores department, to whom has been assigned the work of perpetual inventorying, takes this list and makes an actual count, shows the balance on hand indicated on the bin card, and makes his returns to the balance-of-stores clerk, who checks against his stock records. This inventory work makes it necessary to show the last requisition authorizing the issue of the particular stock item under inventory. An accurate check is only rendered possible by making reference to some particular requisition. A bin ticket record system aids materially in promoting the accuracy of the record in the storeroom itself. Each stock clerk must enter his initials on the bin tag every time he takes out stock. This feature has a salutary effect on the accuracy of the storeroom clerks and tends to prevent them from taking more material from the bins than is required, or from allowing the surplus to lie around the storeroom. A record of this kind should not, however, be made to serve as a regular stock record, since the data is only recorded for quick reference.

This bin ticket contains spaces for the bin number, the mark number of the piece and its name, date received and symbol. At the bottom of the card is a statement of what is to be done when the minimum quantity has been reached. Below the general data is the stock attendant's record, including columns for date and stockman's initials, also columns headed "Amount In," "Amount Out," and "Amount Left."

A temporary bin ticket can also be used for the purpose of drawing special attention to those bins in which the stock is running below the minimum quantity, and contains the same information as the regular ticket, except that it is bright red in

color. This ticket is substituted for the regular one, the latter being sent to the storekeeper. When the regular ticket is returned, the red one is attached to its back and both are hung on the bin until stock is brought up to the required quantity. If the red ticket alone hangs on the bin, then it is known that the storekeeper has been apprised of the fact, but that the stock is below the danger mark. If both tags are hung up, it is indicated that the storekeeper has investigated the matter and that proper steps are being taken.

The purchasing agent should be guided by the specifications furnished by those who have means of knowing exactly what is needed. Such authorities should be the manager, superintendent or storekeeper, who should operate by means of the system of requisitions, orders and receipts of the stores department.

New material should be received at the receiving department, where, by means of a form, all receipts of purchased materials are checked, and their weight and number entered for record. Under no circumstances should the invoice be used as the basis of checking. It is a good plan to make out this form in triplicate, sending a copy to each department interested, the original to the purchasing department; the duplicate with the material to the storekeeper, with the triplicate remaining permanently with the receiving clerk. The purchasing agent, upon receipt of his copy, checks it up, and forwards the original invoice to the storekeeper, who now has a complete file of forms in his records, showing the complete history of every transaction. These forms should all be in one color, with the exception of the dealer's invoice. The storekeeper now possesses all information required to meet any disputes which may arise with reference to the condition of material when received, its count, weight, quality, price, etc., before a record is made of these goods on the stores cards. This feature makes the record a reliable source of reference. Finally, when the storekeeper has checked and signed all the four forms, he sends them to the bookkeeping department for auditing. The storekeeper should always bear in mind that his department is similar to that of a retail store. He orders material, through the general requisition, from the purchasing agent, and then delivers

it to the workmen over their general supply and material requisitions. Great care should be exercised in the issuing of materials, which should never be done except upon the presentation of the proper requisition slip, signed by the right authorities and properly filled out. In all cases this requisition form, issued from the department requiring the material, must show date, quantity, full description, the proper charge account, and the signature of the man ordering.

In supplying an order, the store man issues the material called for on the requisition either to the man presenting the requisition or, in case of large, bulky material, places it in out-going bins plainly marked as to whom the material is for, with the job number that it applies to. If the store man has time when the issue is made, he should enter the amount issued, the job number, and the date on the bin card, subtracting the amount issued from the amount on hand, so as to show the balance on the bin card. He should then copy the symbol of the material issued from the bin card on the requisition and should show the balance on the requisition, initialing this in the space provided. But should he be too busy to correct the bin card at once, he should put all the requisitions into a box marked "not worked," until such time as he can work them. After they have been worked, they should be placed in a box marked "worked." In the case of material issued many times during the day, the stock clerk should collect all requisitions calling for stock of one kind, add them up and make one entry of the total on the bin card, showing the balance on one requisition only. He should, however, initial all requisitions so as to show that they have been worked and included. These he should fasten together with the requisition that shows the total on top.

As soon as the general supply or material requisition has been honored, it should be sent immediately to the stores record office, where the amount of the material drawn should be entered in its proper place on the stores card, the proper balance figured and the price entered on the requisition. After these entries have been made, the requisition should be turned over to the cost department.

Some firms are not so formal in cases where stock parts are being made up. They provide a tag which accompanies the stock order of the individual parts through the shop. This tag is provided with a coupon which serves as an order and receipt for the necessary material. Thus no special requisition is required to draw material, but in case of special repair orders, assembly orders, etc., a material or supply requisition order as mentioned above is used.

As each requisition is extended and the balance carried forward, the balance-of-stores clerk should observe whether or not the stock has reached the minimum. Upon this point depends the automatic arrangement of replenishing stores and he must use his own judgment in cases where the balance is just more than the minimum quantity, depending upon how often and how much material is used. Provided the amount on hand, as shown by the balance-of-stores records, and corroborated by the balance shown on the last requisition received from the storeroom, is down to the minimum, the balance-of-stores clerk will make out a requisition on the purchasing agent for the maximum amount, showing the description and all the necessary data. It should be sent to the head of the department using the material called for. He should also make out a " tickler " for each requisition sent out and should see that it is not held longer than two days by the department to which it has been sent. The requisition is then ready to go to the executive head delegated to approve all purchases. If the latter, after consideration of the material on order, deems it wise to continue to carry the amount shown in stock, he will O. K. the requisition and forward it to the balance-of-stores clerk. When it has been returned, properly signed, the balance-of-stores clerk should enter the data on his records as " on order," and send the requisition to the purchasing agent, who will place the order and send copies of the order to the balance-of-stores clerk and storekeeper, and the original to the firm receiving the order. He should also file two copies in his own office, one numerically, according to the order number, and one alphabetically, according to the name of the purchaser. He should also make out a " tickler " to be used as a follow-up on the order, to assure its prompt delivery.

In operating a plant, it may often be necessary to requisition out of the stores a quantity of material or supplies in bulk for operating purposes. For example, a department may draw out fifty pounds of brass rods for turning purposes, though only twenty-five pounds is used. It would, of course, return the remainder and must, therefore, be given credit for it. To provide for such cases, a special credit slip should be provided for all departments. It should be remembered that a proper system would charge all material drawn from stores to its proper account within twenty-four hours. Therefore, if subsequent information shows that more material was drawn than was needed, it is necessary to record this fact and give credit to the department or job returning the surplus material.

IV. The Perpetual Inventory in Practical Stores Operation [1]

By J. B. Green

Much has been written concerning the principles of scientific management but less regarding the details of its application. The inherent difficulty in attempting a discussion of this phase of the subject is the almost infinite variety of situations existing in different manufacturing plants, each requiring its own special treatment. The manager who is convinced that scientific management is theoretically correct, and has come to the conclusion that he would like to try it, is confronted with the all important question of how to go about it. There are two general methods — to employ a professional industrial engineer, or to do it yourself. This article is addressed to the manager who has selected the latter.

The word " scientific " comes from a Latin root meaning " to know," and scientific management is essentially a management based on knowledge in distinction to one based on guess. The knowledge which is the basis of scientific management is obtained usually in two steps, and may be said to consist of original data

[1] *Engineering Magazine*, March, 1915, pp. 879–888. Reprinted by permission of *Engineering Magazine*.

and derived data. For example, a properly set task and bonus is the knowledge of what is a proper compensation for a given amount of work, and it is derived from data obtained by time study. The cost of manufacturing an article is derived from original records regarding material, labor, and overhead expense. Managers, as a rule, are at least familiar with the methods of obtaining such original records as the accounting department of a scientifically managed plant requires. It is essential that the plant be broadly divided into a stores department and a manufacturing department, and that no transfer of goods of any kind be made from one to the other except on a properly executed written authority. The forms usually used are known as " stores issue cards " and " stores credit slips." It is also necessary that all manufacturing be done on authority of a written factory order. The purchasing department must be so organized that all purchases are covered by a written purchase order. The receipt of all goods must be reported on a material received report. This much is required as the basis for operating a " Balance-of-Stores Record." It is with the practical details of operating such a record that this article is concerned.

Before passing to a discussion of the subject, it is well to realize that all manufacturing may be divided into three classes, usually designated as contract work, job work, and standard product manufacturing. Contract work is done mostly outside of the plant, as building a bridge for example. Job work is done within the plant, but each order is made to the customer's specifications. Standard products are made within the plant to standard specifications and run to stock. The business of any single company may belong to any one of these classes, or it may be a mixture of any two or even include all three. The majority of manufacturing plants represent a mixture of job work and standard product, and it is to this class that special reference will be made. With but a few modifications, however, on some points, the discussion would apply to the other classes as well.

Passing to the practical details of installing and operating a balance-of-stores record, the first consideration is the clerk required to keep the record. In the larger cities, a suitable man

for this position can usually be obtained for $17 to $20 a week. If the work is supervised in detail, it is not necessary to pay more than $12 or $15 a week. The duties of the balance-of-stores clerk are herewith presented in specimen form and later discussed in detail.

Balance-of-Stores Clerk's Duties

1. *Superior Officer.* In the performance of the following duties, the balance-of-stores clerk is under the direct supervision of the chief accountant and reports to him. He coöperates with those making out the original records with which he is concerned in the matter of correcting errors.

2. *Divisions of the Balance-of-Stores Record.* The balance-of-stores clerk keeps the record in four divisions, viz., (1) Raw Material, (2) Semi-finished Material, (3) Finished Goods, and (4) Supplies, subdividing these main divisions as required.

3. *Original Records and Their Use.* The balance-of-stores clerk receives the following forms from other departments and uses them as directed herewith:

(*a*) Copy of Purchase Order: — After making the proper entries in the " ordered " column of the balance-of-stores record, the copy is initialed and filed serially by order number.

(*b*) Copy of Material-Received Report: — After making the proper entries in the " Received," " Balance," and " Available " columns of the balance-of-stores record, the copy is initialed and filed by date.

(*c*) Stores-Credit Slip: — After making the proper entries in the " Received," " Balance," and " Available " columns of the balance-of-stores record, the slip is priced, initialed, and turned over to the stores-distribution clerk.

(*d*) Stores-Issue Card: — After making the proper entries in the " Issued " and " Balance " columns of the balance-of-stores record, the card is priced, initialed, and turned over to the stores-distribution clerk.

(*e*) Shipping Order: — This goes to the balance-of-stores clerk before going to the shipping department. Opposite each item regularly kept in stock, he stamps " Applied," and makes an

Name of Item ______________________

Unit______ Average Weekly Consumption______ Factory Time____Weeks

Minimum Stock	Classification No.
	Quantity to Order

Ordered			Received				Issued			Balance on Hand			Applied on Orders			Available		Remarks
Date	Quantity	Purch. or Fact. Ord. No.	Date	Quantity	Price	On Ord. No.	Date	Quantity	On Ord. No.	Date	Quantity	Price	Date	Quantity	Order No.	Date	Quantity	

BALANCE-OF-STORES RECORD

The original is ruled with horizontal blue lines for individual entries, these lines being omitted in the reproduction. The sheet is 14 in. long by 8½ in. high, perforated for loose-leaf binding.

entry in the "Applied" column of the balance-of-stores record. Opposite each item not kept in stock, he stamps "Requisitioned," and makes out a requisition on the planning department for the goods. The shipping orders are then passed to the shipping department.

(*f*) Copy of Factory Order:—After entering in the "Ordered" column of the balance-of-stores record, the copy is initialed and filed serially by order number.

(*g*) Invoices for Goods Purchased:—After entering the unit price in the price column next to the "Received" column of the balance-of-stores record, the invoice is stamped "Bal. of Strs. Clk.," initialed, and sent to the purchasing department.

4. *Use of Balance-of-Stores Sheet.* The various spaces and columns are filled in as follows:

(*a*) Heading Spaces: — Unit and name are stated briefly but plainly. When a new item is added, the unit and name are obtained from the purchase order or elsewhere as occasion requires. The "Average Weekly Consumption" refers to the quantity sold or otherwise used per week on the average. This is revised at least once in six months, or oftener if there is a great variation in the rate of consumption. In the case of seasonable items where the average weekly consumption varies greatly during different months of the year, the proper average is specified for each season. The "Factory Time" refers to the time in weeks required to manufacture an item plus a factor of safety, making a full allowance for the time required to start a run after the raw material is on hand. It is determined by the planning department. This space applies to finished and semi-finished material only. The "Classification Number" is a mnemonic symbol standing for an item of stores. This is devised by the chief accountant. It is used to index the balance-of-stores record. The "Quantity to Order" is determined by the manager of the stores department. The "Minimum Stock" space is filled in as follows: — Case I; for raw material kept in stock, the minimum equals the time in weeks required to obtain a shipment from the source of supply, multiplied by the average weekly consumption. Case II; for finished goods for which raw

material is specially ordered, the minimum equals the product of the average weekly consumption, the sum of the factory time, and the time in weeks required to obtain a shipment from the source of supply. Case III; for finished goods for which raw material is kept in stock, the minimum equals the factory time multiplied by the average weekly consumption. Case IV; for supplies, the minimum equals a specified quantity determined as directed by the manager of the stores department.

(*b*) "Ordered" Column: — The date, quantity, and order number are posted from the purchase order or factory order, depending on whether the material is purchased from outside or made in factory.

(*c*) "Received" Column: — The date, quantity and order number are posted from material-received reports or stores-credit slips, depending on whether the material is received into stock from an outside source or from the factory. The price is obtained from the invoice or the cost clerk, depending on the same circumstances.

(*d*) "Issued" Column: — The date, quantity, and order number are posted from the issue cards.

(*e*) "Balance on Hand" Column: — Every entry in the "Issued" column is subtracted from the last balance and the difference and date entered. The cost price is entered after every receipt of goods. If this fluctuates violently, the price is reviewed by the manager of the stores department before entry. He may assign an arbitrary average price.

(*f*) "Applied on Orders" Column: — This column is used only in connection with finished goods. Entries are made from the Shipping Orders covering regular stock items, the date and quantity being posted.

(*g*) "Available" Column: — Every entry in the "Applied on Orders" column is subtracted and the difference and date posted. Every entry in the "Received" column is added and the sum and date posted.

(*h*) "Remarks" Column: — This is used as the name implies.

(*i*) Lining up Columns: — In order to keep track readily of various related items, the double lines immediately following the

quantity columns are lined in. Whenever an order has been received complete, the space in the " Ordered " and " Received " columns referring to this order are lined off. The same procedure is followed between " Issued " and " Applied on Orders " columns when the latter is kept.

(*j*) Checking Columns:—The narrow spaces immediately following the double lines after the " Quantity " columns are used for checking purposes.

5. ***Maximum and Minimum.*** The balance-of-stores clerk knows that it is time to replenish stock whenever the sum of goods on order and on hand or available becomes less than the prescribed minimum. A requisition is issued for the specified quantity to order, and sent to the purchasing department in the case of supplies and raw material, and to the planning department in the case of semi-finished and finished goods.

The above represents a statement of the balance-of-stores clerk's duties in such form as they might be issued to him by the chief accountant or other officer. Taking up the various sections of these duties one at a time for discussion, the first relates to the superior officer. The balance-of-stores clerk is under the chief accountant's supervision, because the work is essentially accounting and is so closely related to other features of a general accounting system that it must be under the same supervision.

The second section refers to the division of the record. All materials handled by a manufacturing company may be divided into four main classes, raw, semi-finished, finished, and supplies. The balance-of-stores record should have at least these divisions and further subdivisions as the nature of the business demands. These same divisions are usually made in storing materials, in reporting an inventory, in cost accounting, and numerous other places, and should, therefore, be used in connection with the record so that it will harmonize.

The third paragraph is concerned with original records and their use. The balance-of-stores clerk requisitions the purchasing department for material required and receives back a copy of the purchase order as acknowledgment and advice regarding the date ordered and the order number. This latter is useful in

checking the goods off against the proper order when received. The balance-of-stores clerk's copy of the purchase order is filed serially so as to form a cross index with the purchasing department's copy, which should be filed alphabetically. All original records should be initialed as soon as posted to indicate that the proper entries have been made. A copy of the "Material-Received Report" is essential to keep the record in balance. It is filed by date because a freight bill, or other record, may give only the date, or approximate one, on which an item of material was received and this system of filing makes it easier to locate reports. The record itself furnishes a cross index by order number or name of item.

The "Stores-Credit Slip" is the authority to return goods to stock from the manufacturing departments. The quantity should be recorded in the "Received" column and added to the "Balance" and, in the case of finished goods, to the "Available" column. It is priced at cost and turned over to the stores distribution clerk, who summarizes these and the stores-issue cards and keeps a running inventory in dollars and cents of the stock on hand. This is necessary in order to close the general books once a month so as to derive a monthly profit and loss showing. The credit slips and issue cards are eventually turned over to the cost clerk, who files them permanently by order number or, if they refer to an item of overhead expense, by account symbol.

The stores-issue card is handled the same as a credit slip except that it represents an issue of stock to the manufacturing departments, instead of a credit.

The balance-of-stores clerk receives the shipping order to requisition the planning department for items not in stock, and to keep the quantity available continuously up to date. This makes it possible to advise the sales department at any time just how much of any item is available for sales.

The balance-of-stores clerk should receive a copy of the factory order, for reasons similar to those given in the case of a purchase order. In one case the material is bought from an outside source, and in the other from the manufacturing departments.

After an invoice for goods purchased has been paid, it should go to the balance-of-stores clerk so that he may enter the price.

This should be done from the paid invoice in order to include any price adjustments. The price invariably should be reduced to the same unit as that in which the stock is recorded in the record.

The paragraph concerned with the use of the balance-of-stores sheet probably requires explanation on only a few points. The "Classification Number" is essentially an abbreviation for the name of an item of stock. It may be composed of figures, letters, or a mixture of both. For a complete discussion of this subject, reference should be made to literature on the subject. These symbols serve the purpose of translating shop names to those used by the accounting department, as a basis for setting depreciation rates, as an aid in sorting the cards for posting to the record, and for resorting by the stores distribution clerk, etc. The question of devising and using mnemonic classification symbols is a subject too broad to more than hint at here. The "Quantity to Order" and "Minimum" will be discussed later in connection with the paragraph "Maximum and Minimum." The "Available" and "Applied on Orders" columns may serve a variety of purposes depending on the nature of the business. Uses for these columns will readily suggest themselves. In the above statement of the balance-of-stores clerk's duties these columns are used only in connection with finished goods, but under certain conditions they might prove of greater benefit with one or all of the other classes of material. The essential thing in operating these columns is to have all authorities for the issue of stock from the stores department cross the balance-of-stores clerk's desk first, be entered and stamped "applied." Unless this is done, some stock will be issued without being first applied on orders which will, of course, vitiate the benefits of keeping these columns.

Passing to the next paragraph, the proper setting of the maxima and minima, and the operating of this feature is the most important part of a balance-of-stores record. When the balance on hand plus the quantity on order equals the specified minimum, more stock should be requisitioned. This minimum should be so set that the fresh supply comes in just before the old stock is exhausted. In order to set such a minimum for an item of stock, it is necessary to examine the factors which affect the exhaustion

and replenishing of stock. These are twelve in number when all possible cases are covered. However, it is rarely necessary to consider more than three or four in any particular instance. Following are the twelve factors, the unit of time being the week and the unit of quantity that one decided on as the standard for the balance-of-stores record:

(*a*) Time required by the purchasing department to place an order after receiving a purchase requisition from the balance-of-stores clerk.

(*b*) Time required by the seller to ship the goods after receipt of the purchase order.

(*c*) Time required in transit.

(*d*) Time required to pass goods through the receiving room and to the desired point in the manufacturing department.

(*e*) Time required to manufacture goods.

(*f*) Time required to ship goods after being manufactured.

(*g*) Time required as a factor of safety.

(*h*) Average quantity consumed per week.

(*i*) Balance on hand.

(*j*) Quantity on order.

(*k*) Maximum quantity that a single order might require.

Let L = the allowable minimum quantity. Using the letters indicated above, the sum $(a + b + c + d + e + f + g)$ equals the time in weeks required to secure the raw material and manufacture a lot ready for shipment. This sum multiplied by h gives the quantity sold during the time required to replenish the stock. It might, therefore, be expected that if the balance-of-stores clerk made out a requisition on the purchasing department for raw material when this quantity was left on hand, the new lot would be ready just as the old lot was used up. There must, however, always be enough on hand to fill the maximum order that might be expected, so the factor k is added. It often happens that the quantity to order is small and the time required to obtain raw material is long. In such cases, the factor j must be subtracted. The complete general formula then becomes,

$$L = (a + b + c + d + e + f + g)\,h + k - j,$$

and a requisition should be put through as soon as L becomes less than i. It is not necessary for the balance-of-stores clerk to figure an elaborate formula of this kind. When all of the quantities, $a, b, c, d, e, f, g, h, k$, remain constant, or nearly so, over a period of time such as a year, the formula need be figured but once and the minimum specified on the record as a number. When, however, one or more of these quantities varies enough to warrant the extra work on the part of the balance-of-stores clerk, the formula should be specified on the record, using words instead of letters as very few clerks will readily comprehend the significance of algebraic symbols.

Referring back to the specimen duties of the balance-of-stores clerk, paragraph 4, Case I, the quantity b is regarded as varying so that it must be considered. This would be true for instance in case bar steel were the raw material. This sometimes may be had from the mills in two weeks and sometimes it requires six months. It is obvious that it would be foolish always to keep a six months' supply on hand and yet the supply must come in regularly. This is accomplished by having the purchasing department make monthly or semi-monthly reports to the balance-of-stores clerk regarding the time it takes to get delivery. The purchasing department is instructed to add a factor of safety which shall cover the quantities a and c as well as g. The balance-of-stores clerk should periodically compute h on all items and make such corrections as are required. The quantity k, so far as these specimen duties are concerned, is considered very small and may therefore be neglected. The quantity j does not often enter into the calculation, and when it does is considered by specifying that a requisition should be put through when the sum of the goods on hand and on order becomes less than the prescribed minimum. It will thus be seen that this apparently complicated formula has resolved itself for the case in point into a consideration of but two quantities. After the balance-of-stores clerk has figured a few items by this method, he can usually tell at a glance whether a requisition should be put through. The person setting the minima should make himself very familiar with the theoretical formula as given above and should reduce this to simple terms

covering specific cases which may be practically applied by the balance-of-stores clerk. The case given is but an example. There are probably several hundred different ways in which this formula may be reduced for practical application. By its intelligent use, however, it is possible to keep but a relatively small amount of stock on hand and at the same time always be sure of an adequate supply.

The maximum is, of course, the sum of the minimum quantity and the quantity to order. The quantity to order is dependent on five factors. These are as follows:

P = Average weekly consumption.

Q = Set-up cost plus loss of profit, if any, due to idleness of machine.

R = Shop cost (except preceding item) per unit.

S = Rate of interest plus rate of depreciation, both per week.

T = Storage charges per unit per week.

Then let X = Quantity to order.

It is evident that it costs as much to get ready to make a run of goods if only one piece is made as if a thousand are made, or ten thousand, or whatever quantity can be turned out without re-setting a die or making other changes. Consequently, the more goods that can be manufactured in one lot, the lower will be the cost. Suppose, however, as is usually the case, that these goods must be stored in the warehouse for some time until sold. There is an expense occasioned for warehouse space, money is tied up, the interest on which should be charged against the goods, and there is usually a loss through depreciation. Thus, so far as storing the goods is concerned, the more made at a time, the higher the cost. Here are two forces, so to speak, pulling in opposite directions. There must, therefore, be some point where the cost is a minimum. If the quantity run be smaller than this amount, the increased cost per unit, due to distributing the set-up charges over fewer pieces, more than offsets the reduction in cost of warehousing. On the other hand, if the quantity run be greater than this minimum, the warehouse expense more than offsets the saving in manufacturing cost. That branch of mathematics known as calculus makes it possible to determine the formula which expresses the proper

quantity to order so that the sum of the manufacturing and warehouse expenses shall be a minimum. Expressed algebraically this formula is

$$X = \sqrt{\frac{2PQ}{RS + T}}.$$

Thus, to find out the proper quantity to order in any particular case, it is merely necessary to substitute the proper figures and solve the problem by ordinary arithmetic. No knowledge of either calculus or algebra is required to use this formula. Great care, however, should be taken in getting the units correct. The same unit of quantity must be used for P, R, S, and T. Costs must be written as dollars and decimal parts of a dollar. For instance, if the shop costs is 6 2/10 cents per unit, it must be written $.062. If the proper care is taken regarding the units of quantity and money, it is a comparatively simple matter to figure the right size run to make on each item so as to give the maximum economy. This formula will be found of greatest service in connection with expensive, bulky, perishable goods, with a high set-up charge, and of least service when the reverse is the case.

V. The Stores Department[1]

By George C. Yeomans

The investment of the average railroad in unused material is rapidly increasing. In fifteen years it has increased 283 per cent. This rate is out of all proportion to the increase in any of the units of operation which render a stock of material necessary.

The official figures of the Interstate Commerce Commission show the following increases to have taken place during the same period:

Miles of track	50 per cent.
Freight car miles (10 years)	50 per cent.
Total car miles (partly estimated)	57 per cent.
No. locomotives in service	70 per cent.
No. cars in service	82 per cent.
Tons moved	167 per cent.

[1] *Railway Age Gazette*, vol. 59, pp. 237–238. Reprinted by permission of *Railway Age Gazette*.

Reduced to a "per mile of track" basis, the percentage of increase is as follows:

Unused material	155 per cent.
Freight car miles (10 years)	10 per cent.
Total car miles (partly estimated)	15 per cent.
No. locomotives in service	14 per cent.
No. cars in service	21 per cent.
Tons moved one mile	77 per cent.

Why this enormous discrepancy in the growth of the fixed investment in material?

It must be distinctly borne in mind that this is not an increase in the amount of material *used*, but in the amount of material that is not used and which represents a practically permanent investment.

This distinction is important. Consumption of material should be expected to increase in greater ratio than the units of operation referred to, because railroad operations themselves have greatly increased, both in magnitude and complexity. But a stock of material should not increase in direct proportion to the amount consumed, and, while it could not perhaps be altogether limited to the same ratio of increase as those units with which it is here compared, it is reasonable to assume that so great a difference is wholly unwarranted.

It is unfortunate that more exact information on this subject is not procurable. The units with which comparison is instituted are not those of choice, but of necessity, and the comparison is therefore crude, but the discrepancy between cause and effect is so tremendous as to demand serious consideration.

I do not know a railroad executive who will not admit that this investment is larger than it should be, and who is not trying in some way to curb it, but it is evident that the average way is not the right way, for the disproportionate increase continues. A detailed examination of this situation on ten representative railroads in various parts of the country, coupled with results actually obtained in several cases, point to the conclusion that this investment is nearly twice as large as is necessary on the average railroad.

The amount of capital thus impounded is reported as $240,-000,000, and this is undoubtedly the minimum. If 40 per cent of this money could be recovered, there would be $100,000,000 more of free capital to employ for other purposes.

Analyzed further, this means that the railroads, collectively, have unconsciously expended $100,000,000 for which no real necessity existed. True, it is not lost. The material which it represents will be used some day or, at least, most of it; but it is idle capital and that means expensive capital. When locked up in stocks of material the carrying charges are seldom less than 15 per cent, and frequently as high as 20 per cent. Thus a further expense of some $15,000,000 or $20,000,000 is caused, which is wholly unnecessary.

Why do such conditions exist, and what is the remedy?

Two principal causes contribute to this economic waste and prevent its correction.

1. Absence of exact information regarding the handling of this large investment.

2. A reluctance to depart from long established precedents and customs.

It has come to be generally accepted that the first step toward positive control of this large investment is the creation of an organization to which can be entrusted the care and handling of the stocks and the collection of accurate data concerning them.

Following the example of the pioneers in this reform a majority of the railroads have instituted a "Stores" department, but, as a rule, have placed it in charge of employees whose previous training has all been along the lines of former practice and, through an imperfect conception of the basic principles underlying the effectiveness of such an organization, they have condemned all departures from precedent and expected different results without employing different methods.

Under such conditions the work of the new department has been perfunctory and superficial, for no matter how those in charge of it may strive, they are bound by the dictates of precedent and custom. They must also contend against a natural

jealousy over what has come to be regarded as a " vested right " of the individual or the department in the material they use and an equally natural resentment of what is construed to be an abridgment of long enjoyed authority.

The insignificance of the results obtained under these conditions creates a disbelief in the efficacy of the remedy.

The methods of controlling the investment in material are the only ones that have stood still, on the average railroad, since its inception. They are essentially the same today as when the " Stourbridge Lion " made its first trip.

The efforts at improvement have been mainly directed to facilities for the physical handling of the material, which have an important effect on the labor cost, but none at all on the amount of the investment; unless, possibly, still further to increase it.

It is hard to understand why we cling so tenaciously to customs which have produced the very condition which we seek to correct, and blindly follow precedents established under circumstances that no longer exist; but until we realize that they have outlived their usefulness and are ready to discard them in favor of methods which are better adapted to the changed conditions of modern railroad operation, this unproductive and costly investment will continue to increase.

The only methods by which the stock of material on a railroad can be controlled are the same, in all essential particulars, as those employed by any large and successful department store or mail order house. The same basic principles apply in both cases. It is purely a commercial problem, not one of operation or engineering. There must be the same precision of method, the same accuracy of data, that are necessary to the profitable conduct of any commercial business. The law of averages holds just as good in the consumption of material for the ordinary maintenance and operation of a railroad as in any other field of human endeavor, and this law should be intelligently applied in procuring and limiting the supplies for such work, but the averages must be founded on precise and comprehensive knowledge, and not on estimates or imperfect or incomplete information.

VI. Time Study and Task Work Explained [1]

By Sanford E. Thompson

The primary object of scientific methods of management is to increase the productive capacity of a man or of a machine to reduce eventually the cost of the product to the consumer and at the same time to increase the remuneration of the worker. This must be accomplished not by mere speeding up. It must be done by so arranging the work of the man as to eliminate the unnecessary operation and the waste time and teach him to perform each necessary operation in the best manner possible. It must be done by standardizing the running of the machine so as to fit each one, as regards speed, accuracy and constancy of operation, for the particular work it has to do.

The primary defect in the common types of management, however comprehensive they may be as regards organization, lies in the lack of application of scientific methods. There is a lack of methods which start at the bottom, thoroughly study each element in the process, and then finally adopt a comprehensive plan of management coördinating all the details and all the processes in the plant to produce one effective working combination, with the functions of each individual definitely designated.

This scientific method, the method of starting at the bottom, analyzing operations and standardizing all implements and machines, is difficult; it is slow; it is costly at the beginning. The problem to consider, then, is whether it will produce permanent results that will pay in the long run better than daywork or piecework or the premium plan as commonly employed.

Let us contrast for a moment the usual plan of fixing piece-rates with the time study method. The foreman and superintendent get together, look over records and compare cost records of past performances, and then guess at the speed at which they think a man ought to do the job. In probably ninety-nine cases out of one hundred this guess will be wrong. If the rate is too low the

[1] *Iron Age*, April 24, 1913, pp. 1010–1012. Reprinted by permission of *Iron Age*.

men will fail to earn usual day wages, and a strike is probable. If, as is more apt to be the case, the rates are too high the men soon speed up and earn more than the management thinks they are entitled to. Immediately the rate is cut and the same operation is repeated. After one or two transactions of this kind the men see that it is useless to try to earn a big wage, and when a new rate is set, they fix among themselves a definite output per day that will give them the highest wage that the management will pay. This is no mere theory but is almost universal practice in piece-work shops.

How, then, do methods of scientific time study for rate-fixing differ in principle from the ordinary plan of comparing cost records? The taking of records, the finding how long it has taken a man or a woman to do a certain piece of work, is as old as the hills. Records of outputs on the various machines are given in every factory. The obtaining of such records, however, is not time study.

Let us take for an illustration the making and erecting of forms or molds for reënforced concrete buildings — the forms into which the semi-liquid concrete is poured in order to mold it to the proper dimensions for columns, beams and slabs. The cost of forms is ordinarily figured either in terms of per cubic yard of concrete or else in terms of per square foot of surface area. Neither method is accurate. Take one of the simplest processes, the making up of a side for a column form. The side of a column form consists simply of a panel made up of lengths of boards or planks with wooden cleats nailed across them at intervals. The cleats are placed upon the work-bench, the boards or planks are placed across the cleats and nails are driven to fasten the cleats to the boards.

Suppose in one case we have a form or panel for one side of a column 12 in. square. Suppose in another case we have a similar form for a column 24 in. square. How shall we determine the difference in cost? Based on terms of the cubic yards of concrete in the column, the cost of the form for the 24-in. column should be four times as much as for the 12-in. Based on surface area, the cost for the 24-in. should be twice that of the 12-in. As a matter

of fact, the time of the 24-in. would be only a little over one-third more than 12 in. for making up, with even a less difference than this for the other operation of setting up and removing. Other parts of the work will be governed by still different ratios, so different, in fact, that it is absolutely impossible to figure accurate costs or set tasks by any system of cost records.

Time study does it in this way. It takes the times of the elementary or unit operations of the man who makes the form. It finds out how long it takes him to place one cleat on the bench. It finds how long it takes to place the finished form on the pile. It finds how long it takes to put a single board or plank on the bench. It finds out how long it takes him to drive one nail. By taking a lot of observations on each unit and allowing a definite fixed percentage for the necessary rest it is possible from such unit observations as these to determine the time, and therefore the cost, for making up forms of any shape and size. If a certain form has more cleats, the unit time per cleat must simply be multiplied by the extra number. If more individual boards, the time per board by a different number of boards. If more nails, the time per nail by a different number of nails. By such processes as these it has been found possible to make up accurate tables for times and costs of forms of all lengths and sizes and shapes. By the other method of over-all times, a separate observation would have had to be made on every different length, width, type and design. Records on one job would have been absolutely worthless for another or even for the same job under different conditions.

The same principles apply to other classes of work in the shop or in construction. Time study not only shows the time in which the work should be done but it also assists in standardizing the methods and the implements. In connection with the making of forms, for example, it was found by time study that a certain type of hammer was better than any other. It was found that a certain method of erecting the forms was considerably cheaper than any other plan. It was found that the number and size of nails, which ordinarily varied with each individual carpenter, could be fixed by definite standards to avoid waste in time and materials. It was

found that there were certain methods of handling the lumber which were cheaper than any other way. It was shown by actual figures the saving that could be accomplished by furnishing laborers to do all of the heavy work so that the carpenters could stick to their job of carpentry.

This has been chosen as a typical case. It is always found, even in such simple work as carpentry, when time studies are made and the work is thoroughly analyzed, that processes are improved and waste of time and of material is prevented.

Such studies are expensive. Yes, this is true, so far as the obtaining of original data is concerned. Remember one thing, however; once the data are obtained, the unit times and the standards are adapted not only for that one piece of work, not only for that one locality, but for all processes, anywhere, involving the units observed. You will doubtless agree with me that ordinary over-all records taken in any one shop are absolutely useless for another shop. In time study work it is entirely different, and we have instances of data taken in Philadelphia on the manufacture of one type of machinery being used in Boston for the manufacture of an entirely different type of machinery. While the work was entirely different, the same units were used in the processes. The collection of such data, therefore, in the various trades will eventually prove of universal value.

The most important function of time study, as has been implied, is setting tasks or fixing piece-rates. Time study is useful also for making more exact estimates. It is useful for standardizing implements and machines. It is useful for arranging a gang of men. In a recent civil service examination for a $4000 engineering position, one of the questions asked involved the general principle in laying out a gang of men and horses for hauling earth from a bank to a distance of 1000 feet. Out of seventeen applicants, less than half appreciated the most elementary principle that the number of men loading carts must be governed by the time required for the carts to make the trip to and from the dump.

I wonder how many men who have given attention to this matter are thinking to themselves, " This is all very well for some

kinds of work. It is all right for simple work such as form making, but cannot be done in the work with which I am connected." It is almost amusing, if it were not so serious, to hear some such remark as this repeated over and over again by men in all classes of work with which we come in contact. The most practical answer lies in the fact that time studies have been made and task work or scientific piecework or task work has actually been introduced in so many classes of work that it is possible to state without question that it is of universal application.

Not long ago I attended a conference where the subject of one paper was the limitations of scientific management. The idea was expressed by the writer (who evidently had never come in close contact with the system) that it was applicable to many classes of work, but it was out of the question to apply tasks to the miscellaneous operations in the machine shop. Unfortunately for the reader of the paper, another speaker on the program was the president of a large machine shop, manufacturing not merely standard tools but making up miscellaneous orders. He stated that in his shop scientific methods of management had prevented failure during the hard times of 1907, had greatly increased output, and at the same time had reduced the number of men.

Experience in scientific methods of management has shown positively not only that quality is not reduced, but that it is improved. As a matter of fact, tasks, if properly handled, provide a means for regulating not merely the quantity but also the quality of output. In many classes of work the saving of material is of much greater importance than the saving of time. In such cases, the worker is paid a bonus not simply for time but for quality. In fact, the largest proportion of the bonus is based on the saving of material.

While time study is one of the fundamental principles involved in scientific management and the other processes of management are centered to a considerable extent around the operation of tasks, in the sequence of the introduction of the new management, the setting of tasks is one of the last rather than the first of the operations to perform.

If a manufacturer wishes to take steps to increase his output, he naturally turns first to the consideration of the speed of the operative. How can I get more work out of my men? How can I determine in a scientific manner the amount of work they ought to do in a given time? How can I set the tasks or piece-rates that will be fair? These are ultimate aims of a perfected organization, but instead of indicating the first thing to be done they represent nearly the last. If you begin to set tasks without first getting your machines and your men and your methods of handling your materials into shape you will fail absolutely in accomplishing anything but the most superficial results. It is just here that the scientific method differs most from the rule of thumb method.

The planning of work is necessary in order that time shall not be wasted by the workers in ineffective effort. The routing must be carried to a high degree of excellence in order to distribute the materials properly and permit the setting of individual tasks. The worker must be trained to accomplish properly his task.

Turning to the matter of time study when the plant is ready for it, the first thing that must be done, having obtained the necessary stop watch and blanks for recording observations, is to analyze the operations. A decision must be made as to the elements or units into which each operation must be divided. In the case of form making, for example, the units were placing cleat, placing board, driving nail, placing form on pile, together with certain others of less importance not mentioned. The sequence of operations must be determined so that the times can be readily entered. The time-study man must really learn each trade he observes. Preferably he should be chosen from the plant organization, since it is of much advantage for him to be familiar with the processes. On the other hand a really expert time-study man, because of his power of analysis and of seeing the operations that are taking place, can handle any kind of work and in a very short time will know more of details than the manufacturer himself, simply because it is his job to watch each individual operation.

Standardization of implements and machines must proceed hand in hand with the time study. For example, even in such simple work as handling earth, the proper capacity of the cart or

wheelbarrow must be determined, the size of shovel fixed, and so on. As a matter of fact, this standardization even in simple matters is much more intricate than one would think.

With regard to the process to be followed in observations, the actual time study is best made by taking a record of every operation which a man performs, including not merely the effective work, but the ineffective work and the lost time. The stop watch is started, and the time he completes every operation, including the ineffective ones, is noted on the note sheets. Then, afterwards, the results are studied and the operations tabulated and analyzed to see how long it takes to do the individual elements.

In making time study, the selection of the operative to observe is a very important point. Always select the best workers on the job for your principal observations. Even if the supply of labor is so small that it is impossible to limit the employment, in a particular branch, to men or women who are first-class operatives, relegating the others to some of the places which they are better fitted to fill, the best workers should be selected because they work steadier and their operations are more uniform. Also, the best workers are apt to use the best methods of doing the work and will adopt new suggestions more readily. Observations taken on the best workers do not necessarily mean that these times can be used only for this class. A percentage has to be added to the net times in any case. By properly adjusting this percentage, the rates may be applied either to average workers working at a fair speed or to first-class workers. It is usually a good plan to give the operative you observe a special incentive, such as an addition of 50 per cent to his pay on the day of the observation, as a reward for the trouble you are making him.

Having obtained the time of each of the units or elements by a large number of observations on the operatives selected, we are ready to make combinations of these unit times, so as to obtain the total required time for any operation containing these units. It is frequently convenient to make these combinations by means of a simple formula. For example, taking the making up of the side of a column form, which has already been described, if we let

c = time placing cleat
b = time placing board
n = time driving nail
p = time lifting pile

then assuming 6 cleats, 2 boards and 24 nails, the formula would be

$$6c + 2b + 24n + p.$$

If seven cleats are used, the 6 in the first term would be changed to 7; if three boards are used, the $2b$ would be changed to $3b$, and so on. In practice when task work is really started, these formulas are used to make up permanent tables, showing the total times for all the combinations that are apt to occur.

A percentage always must be added to the observed times before using them to set tasks, to provide for necessary lost time and delay occurring throughout the day. In certain kinds of work 30 per cent is a correct value for this. The per cent to add is governed by the character of the work and whether machine or hand labor. To fix the length of the task, the time thus obtained may now be used directly. If the operative accomplishes the task in this time, he is given his regular day wage for the period plus a substantial bonus. If he does not complete it in the given time, he receives his regular pay without the bonus. If the data are to be used for setting scientific piece-rates or premiums, the plan to be followed is somewhat different but the general principle is the same.

In determining the amount of bonus, bear in mind a fundamental law of Mr. Taylor's, that a man will not do a maximum day's work for an ordinary day's pay. In order to work at the best speed consistent with physical well being, an operative must receive from 25 to 75 per cent higher pay than his ordinary day wages. To provide for required quality of the work, it is necessary, as I have already said, to adjust the bonus so that a man's payment will depend not simply on output, but also on the quality of the product or the amount of material used.

In starting any form of piecework or task work, an essential is to begin with one operative. Get this one well started and making

his or her bonus, before setting another to work. If a number of workers are started at the same time, one or more of them are certain to fall down and fail to accomplish their task in the set time. This immediately gives an opportunity for dissatisfaction. The man or woman selected for the start should be one of the best in the department. He or she should be especially instructed just how to do the work, so that there can be no possible delay in handling the materials, and so that the operation will be accomplished with the fewest motions and by the best methods.

In beginning tasks on a certain line of work, it is frequently advisable to give a longer time than will be adopted permanently, provided, however, it is clearly stated to the operatives that this is simply temporary so as to enable them to become accustomed to the new methods and provided it is also clearly stated that at a certain fixed period the rates will be changed to new definitely stated figures. These permanent figures must be given out before tasks are begun. Never change this regular rate unless radical changes in methods or machinery are made by the management which reduce the amount of labor.

As illustrations of the operation of task and bonus in practice, I may refer to one case of hand labor for girl operatives without machinery, where the reduction in cost averaged about 50 per cent during the first year after installation, while the girls accomplishing their tasks earned 40 per cent more than previously. In another case of two men operating a machine, the reduction in cost was about 35 per cent, notwithstanding a wage increase for tasks accomplished of 40 per cent.

In many classes of machine work, the increase in output is very large because of the standardization of the machine. In certain government work, for example, the increase in output was over two and one-half times. In certain cases of which we have record not merely was the labor cost substantially reduced, but the cost of material was reduced even as much as one-half, due chiefly to the thorough planning and routing of the materials for each piece of work.

VII. The Automatic Rating of Workmen[1]

The United States Armory at Springfield, Mass., has developed to a very high degree of usefulness the governmental system of rating workmen so that all increases in wages, all dismissals from employment, the individual standing of employees in relation to a standard and to one another are determined automatically. The personal equation is eliminated from the management; neither favoritism nor unfavorable prejudice can make itself felt, to help or to injure a workman. Up to a certain point the men are competitors among themselves.

The system constitutes an important element in the general efficiency work of the Armory. It insures a concentration of labor of a degree well beyond that found in most private manufacturing establishments. The visitor is impressed with the industrial discipline; the complete absence of idleness, of conversation between the men; the indifference to incidents foreign to the routine of the shop.

The natural first thought is that a government factory quite naturally assumes an atmosphere of strict discipline because its managers are regular army officers, who are accustomed to absolute obedience to their wishes on the part of their subordinates, under which conditions the advantage over the works of a private manufacturer would seem to be large. An analysis of conditions proves that this is not the case. On the contrary the government shop is handicapped in various ways, especially in the matter of civil service. This excellent institution possesses features which operate against discipline. It serves to tie the hands of the management. Little option is given as to who shall be hired, and summary dismissal is often impossible, even where it may be wholly desirable. The handling of workmen must conform to the laws as enacted by Congress. The employees are not enlisted men. Their relations, man to man, with those in authority are much the same as in a private plant. A large measure of the success that has been attained at Springfield is, of course, directly

[1] *Iron Age*, April 3, 1913, pp. 811–812. Reprinted by permission of *Iron Age*. Illustrations of forms are omitted.

attributable to the personality and the ability of the managing officers, but the statement would be equally true in a discussion of any system designed to give the greatest possible production in an industrial plant.

The automatic rating of workmen is but one element of the shop efficiency system, but it is a very important one. Individual production being high, costs are correspondingly low. Under the present management, the cost of a standard army rifle has been reduced from $15 to $13.67, which is a record as compared with results obtained in the works of the private factories of this and other countries, and in government shops generally. Yet the men work only eight hours a day and are given twenty-seven full days a year with pay, which expense for labor the rifle has to bear. And it should be added that the United States army rifle is conceded to be the finest military arm of its class in use today.

The efficiency report is not new in itself. It has been used in government plants for several years. But its application and the methods employed in getting at the described results have been developed at Springfield with specialized attention until they yield accurate, unprejudiced information of inestimable value.

The efficiency of a workman is the combination of five elements. They are not of equal importance; each has what is known as its "relative weight." Attendance and application each have a unit of one, habits and adaptability a unit of two, and ability a unit of four. The total is efficiency on a scale of one hundred. The card has columns for the analysis of ability and attendance.

To consider the latter factor, the subdivisions are: absence with leave, on account of sickness, without leave and without pay. In the illustrated card J. Smith was in the six months absent fourteen days with leave, twenty days on account of sickness, two days without leave and three days without pay, a total of thirty-nine. The law gives him fifteen days with pay in a year in addition to holidays, all of which count without demerit. Therefore, as J. Smith had had no previous absences with pay in his leave year, the balance against him is twenty-four. The rule is that for each three days of absence beyond the fifteen, one demerit mark shall be registered, and, in addition, there is a penalty of three demerits

for each day without leave. Therefore the workman had seven marks plus six, and the thirteen subtracted from the one hundred of the attendance column leaves him a balance of eighty-seven.

Application and habits are elastic factors. In practice a man is given full credit, one hundred for application and two hundred for habits, unless real reason to the contrary is known. As to adaptability and ability, the records of the employee's labor, especially if he is on piecework, serve to check any opinion favorable or otherwise which may have been formed by his superiors. In the case in question the man is given a full one hundred for application, two hundred for habits and one hundred and eighty for adaptability. Ability is analyzed by the character of the work as specified at the bottom of the card and by the quality and quantity produced. J. Smith is given three hundred and eighty, the unit being four, making his grand total of efficiency nine hundred and forty-seven, or 94.7 per cent. This is his rating. By it we must abide.

The ratings are determined semi-annually. No one man makes the decision as to the various elements of the efficiency card. The matter is in the hands of a board consisting of the officer in charge of the shops, the assistant officer in charge, the general foreman in charge of the shop where the man is employed (there are two plants at Springfield known as the Hill Shop and the Water Shop), the assistant foreman in charge of the particular department in which the workman is employed and the chief inspector. Each of these judges has a more or less intimate acquaintance with the men and their individualities. The production records furnish important knowledge to the board. It is easily seen that injustice is practically an impossibility.

The efficiency card extends to the assistant foremen. Each must secure results. He has no clerical duties to perform, but concentrates on the instruction of his men, on the maintaining of discipline, which means keeping his men working continuously, and on watching production in order that there may be no loss through work which cannot pass inspection. The attitude of the management toward these foremen is unusual. Many a shop superintendent would find it worth while to take a hint from this

element of the system. As has been stated, the foremen are rated like the men. The deciding board consists of the officers in charge of the shop, the assistant officer in charge, the general foreman and the chief inspector. His pay is determined by his percentage of efficiency. If in reducing working forces a foreman is to be dropped, the low man in the list goes, the theory being that each is sufficiently versatile in his ability so that he can, if the need arises, be transferred from one department to another without interfering with the routine of production.

To be efficient he must make his department produce the predetermined quantity of accurate work. Few plants anywhere demand such fine limits of accuracy as those in practical everyday use at Springfield in the manufacture of army rifles, machine guns, bayonets, sabres, scabbards and other equipment of war. To prove the statement, every part of every army rifle must be interchangeable in any other rifle of the model, whether it was made last week or five years ago. Practically all of the men are on piecework; the inspection department is maintained on a most rigid basis, as is demonstrated by the fact that one man in every eight is an inspector. Therefore, unless the work of each workman is gauged by the foreman at frequent intervals each day, he may become careless, and in consequence entail a loss to the Armory and to himself. Each man is presumed to pay for work which he spoils, but this cannot save the government from loss, for the law reads that the financial penalty shall not exceed the workman's daily pay. In a few hours he could ruin the value of many days' wages.

The importance of attention to work is made much of by the Armory. If workmen are observed to be talking too frequently, or otherwise unnecessarily idle or inattentive, they are given a demerit mark, which enters into their efficiency record. Moreover, the foreman is held fully responsible for such occurrences, and their repetition is considered prima facie evidence that his working force is unnecessarily large; that if the required output is achieved where idleness exists the transfer of a man or two to some other department can do no harm, providing that the standard of industry is maintained. So the curtailment is made and

the foreman is compelled to accomplish results with fewer men. It may be stated, however, that the knowledge on the part of the foremen and workmen that these penalties may be expected makes the necessity of their enforcement a very rare occurrence.

On July 1 and January 1 of each year the list of men is made up by class and grade and percentage of efficiency. The system is inexorable. To be sure, an occasional exception may be made in the operation of the system. Annotations occasionally appear against the names of individuals on the list in the records of the management. For example, a highly skilled and faithful man may have dropped to the bottom of his class because of a serious unavoidable illness, such as pneumonia or typhoid. The long absence from labor was a serious matter. Knowledge of the man's previous record may show that apart from this enforced idleness his record has been exceedingly good. The management, therefore, may decide not to drop him in case a dismissal is to be made. But outside of such special cases the system makes no distinction. Illness is considered as a misfortune to the victim; a well man is a more valuable unit in the shop force than an invalid and in justice to the former he is ranked above the man whose health compels frequent absences.

As to the wage rate, the efficiency list removes all causes of controversy. The workman enters the shops on his own basis of pay. If it is found that he is worth more money, the increase comes to him without his solicitation, or it may happen that his earning power is below that which he has claimed, and his pay may decrease as he drops to a lower class. Should a man ask for more wages he is told that changes are made semi-annually only. His card is referred to and he is informed frankly regarding the possibility which awaits him. His efficiency may be increasing, or it may be decreasing, or standing still. He cannot claim that he has been unfairly treated, for his record is as unprejudiced as if kept by an automaton.

He is working in competition with the men who are doing the same class of work. He makes his own record. If he is diligent, skillful, dependable, his standing is correspondingly high. On the other hand, if he is a chronic absentee, if his habits are not good,

or if he is slothful, his percentage of efficiency must be low. He may lose his position because he is at the foot of the list and is the first to be discharged, or his rating may fall so low as to place him in a lower class as to wages.

The percentage of idle hours of workmen has gone down tremendously under the Springfield adaptation of the rating system. The periodic " sickness " following pay day is rare. Few men care to take unnecessary demerit marks. The wholesale desertion for an afternoon or a day which occasionally demoralizes a plant, because of a ball game or other outside event of exceptional interest, is practically unknown.

The rating system has an important place in securing flexibility of production; in other words, the capability of the works to carry an overload. At the present time the output of army rifles is one hundred and fifty per day. Recently it was found desirable to increase production temporarily to two hundred, and the task was accomplished without adding to the working force or to the number of working hours. Each man willingly labored at increased pressure for the time being, without creating confusion, and of course, without decreasing the quality of the product. This is an essentially important factor in a plant which may be called upon at any time to speed up its production. The Springfield Armory shops are equipped to manufacture five hundred rifles per day of eight hours. The machinery is always in complete readiness to be started up and full stocks of material are maintained for that purpose. In case of emergency everything would be in readiness to start manufacturing on a large scale, the existing force going on a basis of extreme production, keeping the output ahead of normal until the full complement of men were recruited. The discipline of the system would be invaluable in such an emergency.

The effect of this efficiency system is shown in the close and intimate relations between the management and the workmen — and on account of this relationship, labor troubles are unknown.

VIII. Hiring and Firing [1]

By Magnus W. Alexander

It must be obvious beyond argument that every unnecessary dismissal of an employee must mean a definite economic waste to the employer, to the employee, and to society. It seems obvious also that the magnitude of this waste and its influence on the industrial situation is by no means clearly understood, otherwise this important phase of the management of men would have received adequate attention before now. Many managers of large businesses, to be sure, have recognized the existence of this problem and have established specialized employment departments to deal with it. They know from experience that it does not pay to hire and fire employees haphazardly; they realize that it costs money to train a new employee, even a skilled workman, in the special practices that are peculiar to a given concern, and that upon his dismissal, save on the ground of no further need, a similar expenditure must be incurred for the training of another new employee, which expenditure only good reason for the dismissal of the previous employee can justify. In only a few instances, however, have employment departments been placed in charge of men of experience and capacity who are competent to deal adequately with the many and often perplexing phases of the employment situation; while still more infrequently have these employment managers been entrusted with the equally, if not even more important duty of continuing their personal interest in the men and women while they are retained in the employment, in order that they may be assured of proper training and fair treatment and may not be discharged without good cause. Without this latter function, which he must share with the superintendent or supervising foreman in harmonious coöperation, no employment manager will be able to bring about a satisfactory solution of the hiring and firing problem.

In order to place this subject concretely before employers so that they may recognize more fully the importance of this phase

[1] Magnus W. Alexander, *Hiring and Firing*, pp. 1–16. An address delivered at the 20th Annual Convention of the National Association of Manufacturers of the United States. Reprinted by permission of the author.

of economical management, I have collected and analyzed various employment statistics and studied various employment conditions in an endeavor to draw the pertinent lesson and to find the obvious remedy. My observations were concerned especially with large, medium-size and small metal manufacturing concerns throughout the United States. A similar investigation in factories in Austria, England, France and Germany during the summer of 1913 has proved, however, that the problem under discussion is of international scope.

The investigation endeavored first to trace the curve of engagements and discharges in the various concerns during the period of one year and then to find out and study the reasons for the discharges of employees. All data were obtained for the year 1912, which may be considered to have been an industrially normal year. The investigation covered the employment and discharge of all classes of employees at the various factories except those belonging to the commercial and engineering organizations and to the general executive staff. A record of those who had entered the service of the concerns for the first time and of those who had been working in the same place at a previous period was also obtained, for it was assumed that re-employment would usually cause a smaller expense than the employment of entirely new people unfamiliar with the conditions prevailing at a given factory.

The figures herewith presented cover the aggregate statistics of twelve factories located in six different states, some employing only male and others employing female as well as male operatives. The great variety of mechanical manufacture in this group of factories ranges from the production of big steam engines, many forms of electrical apparatus and high-class automobiles to that of fine tools and instruments, requiring labor of the highest skill as well as that of the common kind. The smallest of these factories carries normally less than 300, the largest more than 10,000 employees on its payroll. While it would add interest and value to this discussion to analyze separately the statistics of the various concerns in question, it would be obviously wrong to divulge individual figures which were obtained confidentially. It

should be said, however, that these factories can be classed as average or even a little above the average in economical conduct and in respect to such influencing factors as availability of labor, rate of wages and controlling legislative conditions.

A word of explanation is also in order relative to the mathematics of the arguments herein presented. The rate of engagements and of separation from service should be considered separately for each week, and even for each day, in order to arrive at mathematically correct conclusions, since changes in the labor force during a year follow neither a straight line nor any well defined curve, but vary usually according to a most grotesque zigzag line. On the other hand, inasmuch as various factors in the calculation are in themselves of an assumptive character and necessarily introduce into the problem an element of uncertainty, the short cut methods of calculation herein used will be found to give results sufficiently accurate for the purpose. It has been the aim to give conservative values to all assumptions, and these are briefly explained so that anyone with different judgment may readily substitute his assumptions and carry the calculation through on that basis. Most industrial managers, however, I feel confident, will subscribe to the premises herein stated.

In the twelve factories above alluded to, statistics show seventy-two and eight-tenths per cent of the employees engaged during the year had not been employed in these factories before, while twenty-seven and two-tenths per cent had worked in the same factories during one or several previous periods. As a general proposition these percentages will be found to apply fairly well to any normal employment in the mechanical industries.

This group of factories gave employment to 37,274 employees at the beginning and 43,971 at the end of the year 1912. The net increase in the working force, as between January 1 and December 31, amounted therefore to 6,697 employees, while during the same period 42,571 people had been hired and accordingly, 35,874 had dropped out of the employment for whatsoever reason. In other words, about six and one-third times as many people had to be engaged during the year as constituted the permanent increase of the force at the end of that period.

Several reasons might be given in explanation of this condition. It might be stated that the labor market in a given locality was in part responsible for the situation; it might be claimed that in a particular plant a temporary piece of work had to be done, such as the building of a structure or the digging of a foundation, for which labor in excess of the normal quota was temporarily needed, to be dispensed with again when the special work was finished. Unusual conditions of employment might have been the result of a highly fluctuating productive situation, brought about in turn by a largely varying commercial demand on the factories during the four seasons of the year. Above all else, sight must not be lost of the fact that a certain amount of separation from the service is unavoidable and must be reckoned with, such as results from death and prolonged sickness of employees and from the necessary discharge of some and the voluntary resignation of others in the working force.

The important fact, however, stands out that 42,571 people had to be engaged during the year in order to increase the working force by only 6,697.

Theoretically, only as many people ought to have been hired as were needed permanently to increase the force. Practically, certain allowances must be made in order to view the problem in its correct light. These allowances must cover:

(*a*) The replacement of employees who die;

(*b*) The replacement of employees on prolonged sick leave for whom others must be substituted temporarily;

(*c*) The replacement of employees who, although they had been selected for their positions with good judgment, are found to be unsuited to the work or unfit on account of personal characteristics, or who leave of their own accord because they do not find the work congenial, the climatic conditions acceptable, or who for other reasons remove from the locality;

(*d*) The engagement of extra employees required for short periods, either on account of a temporary piece of construction work or usually on account of the high peaks of a fluctuating production; and

(e) The recognized fact that no employment department can be run on a 100 per cent efficiency basis.

The substitution of fair numerical values for these items will indicate the probable number of necessary engagements that will have to be made in any event, even though the numerical strength of an employment is merely maintained and the now prevailing weaknesses in the employment situation are removed.

It may be assumed that among all employees annually:

One per cent die;

Four per cent are sick so long as to necessitate their replacement temporarily or permanently;

Eight per cent withdraw from service for unforeseen or unavoidable reasons, or are discharged for justifiable causes;

Eight per cent are temporarily needed on account of normal fluctuation of production; and

Eighty per cent constitutes a readily attainable efficiency of an employment department.

These figures find their support in the following considerations:

Mortality tables give the death rate of men and women in general employment in accordance with the age of such persons. The average age of employees in the factories under consideration was therefore ascertained and found to be thirty-one and one-half years for male and twenty-three years for female employees. For these ages mortality tables place the death rate of male employees at eight and five-tenths and of female employees at seven and ninety-five hundredths in each thousand. On the other hand, the experience of several mutual benefit associations in factories, some extending over a period of ten years, revealed that about seven in every thousand members had died annually. These statistics, therefore, justify the assumption that death removes annually not more than one per cent of factory employees.

The average number of persons in every thousand who are annually incapacitated by sickness or accident from work for definite periods cannot readily be learned from statistics, unless recourse is taken to experiences in the German Empire, and then

other factors of the situation will also have to be taken into account. Meager statistics of mutual benefit associations in factories and in particular the judgment of industrial managers and assistants must therefore serve as a basis for any assumption of this character. In this connection it must also be recognized that it is the prevailing custom in most factories to carry on sick leave for periods of many weeks and often several months those of whose sickness the management has definite knowledge, and not to replace sick employees, even temporarily, unless their absence from work should extend over a sufficiently long time to interfere seriously with the proper conduct of work. For the above reasons, then, the assumption that annually 4 per cent of the working force will have to be hired temporarily or permanently, to take the places of sick employees, should liberally reflect actual conditions.

As to the number of people who are annually separated from the service for reasons other than death or prolonged sickness, no reliable figures seem to be available. In fact, the only concrete information bearing on this subject seems to be that given by the United States Civil Service Commission, according to which 8 per cent of all Government employees are separated from the service annually for any reason, including that of death and sickness. While in the case of Government employees replacement on account of death could again be assumed as 1 per cent that due to prolonged sickness should be placed lower than 4 per cent and might usually not be more than 3 per cent, on account of the liberality of treatment of Government employees and the lack of competitive commercial conditions in the Government service. From this it would follow that the annual separation from service among Government employees for other reasons than those of death and sickness might be about 4 per cent. Realizing, however, that Government employment conditions are usually more favorable to stability of service than those prevailing in commercial industrial establishments, due allowance has been made for this difference by doubling the Government estimate and, therefore, allowing 8 per cent for withdrawal by voluntary or involuntary resignation alone.

The effect of a normally fluctuating production upon the numerical strength of the working body is difficult to estimate. Opinions differ widely as to how far production can be fairly evenly distributed over the whole year, but the conviction is making itself felt among employers that in most businesses the prevalent erratic curve of productive requirements can be turned into a more even wave line. Several interesting evidences are already available to show the effect of well-directed effort in this field. It must, nevertheless, be admitted that certain fluctuations of production are unavoidable; to a certain extent the seasonal character of a business, and more pertinently, commercial prosperity or depression, are determining and uncontrollable factors. A correct assumption is made so much the more difficult also because normal productive fluctuations will but little affect certain classes of employees, such as highly skilled mechanics and clerks, while the great body of operatives or pieceworkers will almost instantaneously feel the effect of these fluctuations. The opinion of many who were consulted seems to center around the assumption that for all employees and for a normally fluctuating production an annual temporary engagement of 8 per cent of the total number of employees would be justified.

Finally, in regard to the efficient conduct of an employment department, it should not be difficult to attain an efficiency of at least 80 per cent in this highly specialized branch of service with but a very limited staff.

Applying the factors above outlined to the problem in hand, it follows that while theoretically only 6,697 employees should have been employed to allow for an increase of the working force by that number, the additional engagement of 13,843 persons or a total engagement of 20,540 [1] persons would be justified to cover withdrawals by death, sickness or resignation to allow for pro-

[1] Replacement of initial force = 21% of 37,274 on 80% basis of hiring efficiency	= 9,785
Replacement of replacement = ½ of (21% of 9,785 on 80% basis)	= 1,285
Permanent increase of force	= 6,697
Additional increase for permanent increase on 80% basis	= 1,674
Replacement of total increase = ½ of (21% of 6,697 + 1,674 on 80% basis)	= 1,099
Total	= 20,540

ductive fluctuations and for practical employment results and to cover the permanent increase in the force.

Yet the fact is that 42,571 employees were engaged where the engagement of only 20,540 [1] persons could readily be defended; 22,031 persons were, therefore, engaged above the apparently necessary requirements.

It is obvious that a considerable sum of money must have been wasted in unnecessarily engaging so large a force of men and women. The picture herewith presented will become at once more lucid and more appealing if the figures are given monetary values.

No reliable investigation seems to have been made and published in respect to such financial valuation. Industrial managers were, therefore, interviewed in an effort to obtain from them a consensus of opinion, but they were found to be rather loath to express their views because they had not given heretofore serious thought to the question. While one manager estimated the cost of hiring and breaking in an employee at $30, the estimates of all others ranged from $50 to $200 per employee. The great difference in these estimates is no doubt due to the diversity of the industries represented by these managers. Most estimates ranged between $50 and $100. One machine tool builder, usually keen in following up matters of this kind when they have been called to his attention, looked into the subject with some care and stated it as his belief that the engagement of almost 1,000 persons in his plant during one year, while the permanent increase in his force amounted to less than 50, reduced his profits by fully $150,000. His estimate, therefore, is about $150 per employee. The head of a large automobile manufacturing concern stated with equal positiveness that the engagement of a new employee would involve the expenditure of at least $100. This statement is so much the more surprising as it is well known that on account of the high wages paid in the automobile industry it should not be difficult to secure the best type of employees, both as to technical skill and general discipline, and to hold them fairly well. Still another manager

[1] See footnote, p. 464.

who employs a great deal of female labor estimated this cost in some departments to run as high as $200 per employee, largely on account of the costliness of the material which these employees handle.

Unquestionably the skill, experience and intelligence of a new employee have much bearing upon the amount of money that needs to be expended for his training. Another important consideration is whether the new employee is working on expensive or low-priced machinery or with high or low-priced tools, or on expensive or cheap materials; and to a certain extent whether or not he has been employed before in the same shop and particularly on the same class of work.

With this thought in mind I subdivided the employees under investigation into five groups and studied the requirements of each group as to the quantity and quality of required instruction for new employees and the effect of the work of new employees upon the economical conduct of the business.

Group A comprises highly skilled mechanics who must have practiced their trade for a number of years in order to attain the required degree of all-around experience and proficiency;

Group B comprises mechanics of lesser skill and experience who can acquire an average degree of proficiency within a year or two;

Group C contains the large number of operatives usually known as pieceworkers, who without any previous skill or experience in the particular work can attain fair efficiency within a few months, somewhat depending on the character of the work;

Group D includes all unskilled productive and expense laborers who can readily be replaced in the course of a few days; and

Group E is composed of the clerical force in the shops and offices.

The distribution of the employees in these five groups was found to be as given in the table below, assuming that 73 per cent in each group were newly hired and 27 per cent were re-hired employees.

The next task is to find how many employees in each group were apparently unnecessarily hired. Approximately correct

Group	Number of Employees Initial	Increase	Total Engagements All	New	Re-Hired
A	3,355	626	4,661	3,393	1,268
B	4,473	814	6,296	4,583	1,713
C	12,673	2,327	14,440	10,512	3,928
D	13,046	2,369	14,321	10,426	3,895
E	3,727	561	2,853	2,077	776
All	37,274	6,697	42,571	30,991	11,580

results will be obtained by employing for each group the same method of calculation as was used for finding the number of unnecessarily engaged persons in the total number of employees. In order to secure more correct figures, allowance would have to be made for the fact that while the same mortality and sickness rate and the same employment efficiency may be considered to hold in all groups, the rates of withdrawals by resignation and discharge and the effect of a normally fluctuating production will vary for each group. On the one hand, skilled employees are more steady and will give less cause for discharge than ordinary pieceworkers or expense laborers; on the other hand, all-around mechanics will be retained under normally fluctuating production, while again, pieceworkers and expense laborers will more or less immediately feel the effect of such fluctuations.

Using the short cut method rather than entering into an extended mathematical calculation, it will be found that the apparently unnecessarily engaged 22,031 persons divide themselves as follows: —

Group	Unnecessary Engagements All	New	Re-Hired
A	2,781	2,031	750
B	3,818	2,787	1,031
C	7,388	5,393	1,995
D	7,100	5,183	1,917
E	944	689	255
All	22,031	16,083	5,948

The factors which contribute mainly to the cost of hiring and training new employees must now be analyzed. This cost may be considered to result from:

(*a*) Clerical work in connection with the hiring process;
(*b*) Instruction of new employees by foremen and assistants;
(*c*) Increased wear and tear of machinery and tools by new employees;
(*d*) Reduced rate of production during early period of employment; and
(*e*) Increased amount of spoiled work by new employees.

No account is taken here of the reduced profits due to a reduced production, nor of the investment cost of increased equipment on account of the decreased productivity of machines on which new employees are being broken in.

The hiring expense affects all groups of labor to about the same extent. It consists of interviewing applicants, taking their records, making out their engagement cards and other necessary papers, and placing their names on the payroll books; sometimes also advertising and traveling expenses will have to be incurred. Reduced to the cost per individual, an expense of fifty cents for each employee should be a fair estimate.

The instruction expense, on the other hand, will vary largely according to the experience and skill of the new employee and the nature of his work. It will be lowest for Group D and highest for Group C employees, for the latter must be instructed most and watched longest. This expense for Group B employees will be nearly as large as that for Group C employees, not because they need as prolonged supervision, but because higher priced foremen will have to give the instruction. Considering the quantity and quality of required instruction, this expense may be assumed to be for each new employee: in Group A, seven dollars and fifty cents; in Group B, fifteen dollars; in Group C, twenty dollars; in Group D, two dollars; and in Group E, seven dollars and fifty cents.

The value of increased wear and tear of machinery and tools by new employees is difficult to estimate. It will be little, if anything, for employees in Groups D and E, for whom it may be presumed to be one dollar per employee, while it may reach thousands of dollars for damage to expensive machinery used by employees in Groups A, B, and C. Any estimate must be a mere

guess, but it may be conservative to assign ten dollars for each employee in Groups A, B and C.

The loss due to reduced production is entirely dependent upon the value of the article produced and the experience and skill of the employee required for its production. It will, of course, be lowest for Group D employees, for whom it may be assumed to amount to five dollars each. It can be estimated with approximate correctness for other employees by considering their average wages and the average loss of productivity during their initial period of employment. Figuring overhead charges as 100 per cent of the wages of men in Groups A and B, 75 per cent of Groups C and D and 40 per cent of Group E men, this loss may be assumed to amount to twenty dollars for each Group A, eighteen dollars for each Group B, thirty-three dollars for each Group C, five dollars for each Group D, and twenty dollars for each Group E employee.

The expense due to spoiled work will similarly vary with the value of the raw material worked upon and the labor expended in such work. It will amount to practically nothing for employees in Groups D and E, and may be assumed to be ten dollars for each Group A, fifteen dollars for each Group B, and ten dollars for each Group C employee.

These cost items must be reduced materially when they are applied to re-hired employees. The cost of training old employees will, of course, be smallest when these employees are put back on exactly the same or similar work to that on which they were engaged before they left employment in the same factory. As a matter of fact, many re-hired employees are put on entirely new work, and their training will therefore involve an expenditure which will more or less approximate that needed for the training of entirely new employees. Making, however, a conservative assumption, the cost of hiring and training old employees may be placed at ten dollars for each Group A, twenty dollars for each Group B, thirty-five dollars for each Group C, five dollars for each Group D, and ten dollars for each Group E employee. The respective totals of the various cost items above outlined are shown in the following tabulation: —

	New Employees						Re-Hired
Group	Hiring	Instruction	Wear and Tear	Reduced Production	Spoiled Work	Total	Re-Hired Employees
A	$0.50	$7.50	$10.00	$20.00	$10.00	$48.00	$10.00
B	.50	15.00	10.00	18.00	15.00	58.50	20.00
C	.50	20.00	10.00	33.00	10.00	73.50	35.00
D	.50	2.00	1.00	5.00	....	8.50	5.00
E	.50	7.50	1.00	20.00	....	29.00	10.00

When these values are multiplied with the number of supposedly unnecessarily engaged new and re-hired employees in each group, the result shows that the apparently unnecessary engagement of 22,031 employees within one year in the twelve factories under investigation involved an economic waste of $831,030. This amount will grow even beyond the one million dollar mark, if the decrease of profits due to reduced production, the increase of expenses on account of enlarged equipment investment, and the greater cost for accidental injuries and their consequences for newly engaged employees are taken into consideration.

The important question immediately arises: how can this economic waste be avoided in the future?

Preventing Waste in Hiring

Five answers present themselves:

1. A thorough study of current employment statistics with a careful analysis of the reasons for the discharge of employees is needed in order to furnish a fact basis of local as well as general conditions on which to predicate further action;

2. High grade men must be placed in charge of hiring departments and must be given adequate authority;

3. Proper methods must be devised for taking care of new employees, not only in respect to their technical training and work, but also in reference to their personal characteristics;

4. Effective systems of apprenticeship for boys and girls and of specialized training courses for adult employees must be maintained; and

5. Well-directed efforts should be made so to regulate commercial requirements as to secure a fairly uniform production throughout the year.

It is well known that the explanation for an employee's separation from the service, as given by the foreman, cannot always be relied upon because, when the employee leaves voluntarily, he will often give an excuse rather than a reason for his resignation, while in case of his discharge by the foreman the latter's personal bias may sometimes take the place of his good judgment. Special efforts should therefore be made to get at the real cause of an employee's resignation or discharge. Such efforts may reveal, for instance, that the peculiar methods of a foreman readily discourage new employees from continuing in the service, in which case " a word to the wise " may be sufficient to alter the foreman's tactics or other measures may become necessary in order to correct an unsatisfactory condition. On the other hand, it may transpire that certain changes in the character of work or in the conditions that surround the work must be made to attract and keep satisfactory employees.

In the light of the above statements and figures it must be obvious also that the highest grade of judgment in the hiring and discharging of employees is needed. The employment " clerk " of today will have to be replaced by the employment " superintendent " of tomorrow, not merely by changing the title and salary of the incumbent of the office, but by placing in charge of this important branch of management a man whose character, breadth of view and capacity eminently qualify him for the discharge of these duties. Second in importance to the manager of the plant should be his assistant who is entrusted with the duty of bringing into the plant the men and women who are needed for the proper performance of work, and of keeping them in the employment as contented and efficient employees.

While it is quite important to select the right men and women for the right places so that a square peg may be chosen for a square hole and a round peg for a round hole, it is far more important properly to take care of these men and women when they enter upon their new work. A good man can be spoiled and discouraged by wrong initial treatment, as an improperly selected man can often be made useful and contented by the right guidance and training. An understanding of human nature, and fairness and

firmness in dealing with men are some of the chief requisites of the efficient superintendent of employment. A student of economics applied to industry, he must be imaginative enough to be progressive and yet sufficiently conservative not to break away from old moorings before he has found a clear course ahead. Standing between the employees and their employer, he can, if he is the right man, work to the advantage of both by being fair to both. And if he possesses tact and diplomacy he will never destroy the disciplinary authority of the foreman even though the latter is deprived of the right to discharge an employee beyond terminating at any time the latter's connection with his department. Since the superintendent of employment has brought the employee into the factory, he ought to be the one to discharge him if he should be discharged. Often he may find that the employee's unsatisfactory showing was due to his having been placed wrongly. How much better to take this square peg out of a round hole and fit him into a vacant square hole than to discharge him and then experiment with another recruit, a supposedly square peg? Sometimes, where all blame cannot be apportioned to the employee, his first offense can be condoned and he can be placed under surroundings which will be more favorable to his useful development. Again, at times the discharge of an employee may not only be justified but such employee ought to be made to feel in no uncertain way the disgrace of his action. Even in this instance, however, a wise superintendent of employment will fire the employee in such a manner that the latter will greatly feel the sore spot without harboring at the same time hateful resentment against his employer. A friendly public opinion of a community is a great asset to an employer and particularly to a corporation; care should therefore be taken that it be not easily disturbed.

The employer can further help to develop a good relationship with his community by offering to some of the boys and girls of his own employees or of other local citizens an opportunity to prepare in his factory for a useful industrial life. It is becoming recognized again, as it was decades ago, that the employer has a peculiar duty to perform toward his employees and himself as

well as the industry, by offering to train and by properly training the youth of the land who wish, or by circumstances may be obliged to choose a vocational career for a livelihood. Sometimes by his own action, sometimes in coöperation with educational institutions, but always in sympathetic support of the well-meant efforts of school authorities, he should see to it that the young men and women whom he is training become intelligent, skillful and contented workers and leaders in the constantly growing industrial army. Although to a certain extent all employers take an interest in this problem of providing an adequate supply of properly trained workers, most of them have not yet discovered that it is essentially worth their while to set aside a generous amount of their busy time and to devote appropriate effort and financial support for this work.

Finally, as to the last suggested remedy, that of a fairly evenly distributed production throughout the year, the problem looks somewhat simple although it is fraught with many difficulties that arise from the fact that, after all, the buying public is the real master of this situation. The employer can, however, influence the public in many ways, by educational propaganda or by the offer of advantageous trade prices, to help him in his effort for a standardization of his products, so that he may be able to manufacture for stock for future need as well as for immediate delivery, and through it to maintain fairly steady work throughout the whole year. He may well share with the public and with his employees the advantages accruing to him from a wholesale production and the resulting steady work for his employees.

Along the five lines of remedy herein suggested may be found the solution of a problem which is beginning to loom large before our eyes and will look larger as international competition grows keener. In presenting the results of my investigation into the waste of hiring and firing employees, I have made no effort to paint a black picture but have merely presented the varied colors of the industrial spectrum. I have pictured what seems to be an average condition throughout the country, indicative of defects in our factory system that challenge immediate attention.

In view of certain legislative and administrative tendencies now affecting American industries it is important also to reflect that constant fluctuation in the working force of an establishment must materially increase the difficulty of maintaining among the employees a spirit of loyalty to the management, *esprit de corps*, and general contentment. Just as quicksand cannot be kneaded in the hands into a solid lump, so also will it be found difficult to take hold of an ever-changing mass of employees and transform it into a homogeneous, intelligent, contented body. Moreover, this condition will tend to nullify, to a large degree, the beneficial effects of many well-intentioned efforts of employers, such as sickness and accident insurance plans, old age pension systems, and other phases of industrial betterment work.

And last, but not least, the problem herewith presented offers an opportunity for constructive work in which employers and employees can readily be brought together for mutual benefit; for no right-thinking man, whatever his position or affiliation, can justly object to any well-directed plan which seeks to give employees continuous work throughout the year and to enable employers to maintain steady production.

Close analysis of the men and women whom we take into our employ, effective systems under which we train them in our work, fair treatment while they are in our service, and adequate methods to insure their dismissal only for justified cause or their voluntary withdrawal with no ill-feeling toward their employer — these are essential factors in our problem of " hiring and firing " and must be our earnest concern lest we waste money in our businesses and sacrifice friendly relationship with our employees.

IX. A Graphical Daily Balance in Manufacture[1]

By H. L. Gantt

1. At the December meeting in 1901 the writer presented a paper entitled "A Bonus System of Rewarding Labor," in which was given an account of the results gotten under that system at the

[1] *Transactions of American Society of Mechanical Engineers*, vol. 24, pp. 1322–1331. Reprinted by permission of the American Society of Mechanical Engineers. Illustration of one form is omitted.

works of the Bethlehem Steel Company, and a description of the method employed.

The paper dealt particularly with the method of setting a task and with the reward for its accomplishment. It consisted briefly in setting as a task for a day's work the amount that a good man could reasonably be expected to accomplish, and paying the man a substantial amount in addition to his day's wages if the whole amount was done. If less than that amount was done he simply got his day's wages.

The result of this system, when the task was set in an intelligent manner and accompanied by a suitable compensation, was an efficiency of operation so far beyond that obtained by the ordinary day or piecework method that it attracted a great deal of attention.

This centering of the attention on the result had, however, a serious disadvantage, for it withdrew the attention from the most important parts of the paper — namely, that describing the method of setting the task, and that referring to the method of operating the system by which an exact record was kept.

The method of setting the task is substantially that developed by Mr. Fred W. Taylor for setting piece-rates, and was described at some length. His paper before the present meeting further elucidates that part.

The routine operation of the system, which involves keeping an exact daily record of the work done, was not, however, so clearly explained, and it is to that subject that this paper is devoted.

2. *Man's Record.* In order to operate such a system we must not only have an exact record of what each workman does every day in order to find out whether he has earned his bonus or not, but must have beforehand an exact knowledge of the work to be done and how it is to be done. This amounts to keeping two sets of balances: one, of what each workman should do and did do; the other, of the amount of work to be done and is done. The former, or man's record, is concerned with the payment of the bonus, and consists in an exact comparison of what should be done as determined by our investigations, and what has been done as shown by the daily reports.

3. *Daily Balance of Work.* The latter is a balance of work on each order, and should show at a glance each day just what has been done and what remains to be done, in order to enable us to lay out the work for the next day in the most economical manner. The importance of such a balance has been long recognized, but the difficulty of getting it is such that it has seldom been attempted. Many concerns get a weekly or monthly balance; but in both of these cases the information is usually obtained too late to prevent delays in work. Again the value of a balance is dependent largely upon its availability; in other words, upon the ease with which the desired information can be obtained from it. With this idea in mind the writer devised a combined schedule for work and a balance sheet that is largely graphical in its nature. On it dates are represented by positions, and when work is not done on consecutive days, there are no entries in consecutive positions. This practice enables the foreman or superintendent to see at a glance what work is going along properly. Such schedules can be made out for all classes of work, and a description of one or two will amply illustrate the principle.

4. *A Foundry Balance.* Figure I represents such a balance sheet and schedule for a foundry. At the heads of the various vertical columns are the names of the pieces to be cast; under each is its pattern number; then, in order, when the pattern is due at the foundry, when it is received, the number wanted per day, and the total number wanted. Below, each column is divided into two columns headed daily and total. These are crossed by horizontal lines representing consecutive working days, on each of which is entered in the proper column the number of pieces made that day and the total number made to that date. Each column is crossed by two heavy horizontal lines, the upper one opposite the date at which the work should be begun, and the lower one opposite the date at which the work should be completed. These lines are usually red, and have been very appropriately named danger lines. The position of the entries with reference to these danger lines and the amounts of those entries show to what extent the schedule is being lived up to. If the schedule is being well followed the entries are always in the neighborhood of the red lines, or above them.

FOUNDRY PRODUCTION SHEET.
A. L. CO. SCHENECTADY WORKS.

ORDER NO. 83
8 ENGINES D. L. & W.

PART.	Bell Stand.		Exhaust Pipe.		Tender Frame Center Pin.		Engine Truck Swing Bolster.		Grate Bar.		Grate Side.		Grate Side.		Ash Pan End.		Ash Pan Side.		Grate Frame Support.		Grate Bar.	
PATTERN NO.	17,212		17,939		16,927		16,907		19,458		18,953		18,954		21,343		21,341		18,959		18,961	
PATTERN DUE.	2—2		2—2		2—2		2—2		2—2		2—2		2—2		2—2		2—2		2—2		2—2	
PATTERN REC'D.	1—22		1—22		2—6		2—4		2—9		2—10		2—10		2—10		2—10		2—14		2—14	
NO. WANTED PER DAY.	1		1		1		1		8		2		2		1		1		1		1	
TOTAL NO. WANTED.	8		8		8		8		64		16		16		8		8		8		8	
NUMBER MOULDED.	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total
1903 Feb. 2																						
3			1	1																		
4			2	3																		
5			2	5			1	1														
6																						
7	*7*		*1* 1	5																		
9			2	7	2	2	1	2	*P*													
10							1	3	3	3	1 *P*	1	1 *P*	1	*P*		*P*					
11	4	4					1	4	*1* 8	10	2	3	2	3	1	1						
12	*1* 2	5	1	8	2	4	1	5	*7* 2	5	1	4	1	4	2	3						
13					3	7	1	6			2	6	2	6	*1*	2	3	3				
14	1	6					1	7	8	13	1	7	1	7					*P*		*P*	
16	2	8			1	8	1	8	*1* 5	17	1	8	1	8	2	4	1	4	3	3	2	2
17									*1* 8	24	1	9	1	9	2	6			4	7	2	4
18									*2* 8	30	1	10	1	10	2	8	2	6	1	8	*1* 2	5
19									*1* 8	37	2	12	2	12			2	8			*1* 1	5
20									8	45	2	14	2	14								
21									8	53	2	16	2	16								
23									*1* 7	59											1	6
24									5	64											1	7
25																					1	8
26																						

Begin moulding not later than date opposite *upper heavy* line.
Finish " " " " " " *lower* " "

This is a Portion of an Order Showing how the Records were Actually Kept. The Figures in Italics Represent Condemnations. They are Usually Entered in Red Ink.

Fig. I.

Figure I represents a portion of an actual order showing how it was filled in the foundry of the Schenectady works. If there is no graphical check on the operations of the foundry, the work that is wanted during a certain week may be spread over three or four.

It is an extremely difficult matter for a foreman to get the work done exactly in the order it is wanted. For instance, if we are building two locomotives per day, each requiring four driving boxes, it seems an extremely difficult thing for him to get every day, without fail, at least eight driving boxes. There is a constant tendency when he is rushed with work to drop to seven or six with a corresponding decrease in output of locomotives. This tendency to give about what is wanted rather than exactly what is wanted is the most common obstacle to getting the full output of a plant.

5. *A Daily Balance as a Permanent Record.* This balance sheet shows not only how much work was done each day, but is a permanent record of exactly how the order was filled, which can be compared with the record of the previous and subsequent orders. This is best illustrated by a study of Figure I, which shows exactly where failure to comply with the schedule occurred. The letter *P* entered in some of the columns shows graphically the reason for the castings being behind. The pattern was not received until the date indicated. Similar sheets might show that it was the draftsman and not the pattern-maker who was to blame.

6. *A Machine Shop Balance and Routing Sheet.* Figure II is a similar balance sheet for work done in a machine shop on a series of locomotive frames and rails. The order in which the various operations are to be performed has been determined, and the consecutive columns devoted to the operations in their proper order. You will note that on this sheet, which is an actual record of work, the consecutive operations were performed promptly, and that there was no serious delay.

Figure III represents a record of the same work as it would appear if the works were short of frame-drilling capacity and the drilling of frames were not done promptly. If it is impossible to

make up the delay thus caused, the output is limited by it. Such sheets show at a glance where the delays occur and indicate what must have our attention in order to keep up the proper output. If the delay is always on the same operation, we know that we must either get more output from the machines doing that work, or get more machines. Lines representing when work should be begun and when it should be finished are used on the machine-shop sheets as well as on the foundry sheet, but have been left off to avoid confusion.

7. *A Graphical Balance as a History.* A complete set of such sheets for all the work being done in a plant gives a complete schedule and a daily record of what is being done and is of the greatest possible advantage, if an attempt is to be made to improve the conditions or increase the output of the plant. In fact, if the improvement in the operation of a plant is to be made in a scientific manner, exact knowledge of what is taking place each day is absolutely necessary. Without it money is often spent wastefully, and but a small proportion of the desired results obtained. In large plants run without such a system of balances it is frequently impossible to tell just what is holding back the output, and then the value of such a balance is out of all proportion to the cost of obtaining it. By using the graphical form its value is very much increased, for the general appearance of the sheet is sufficient to tell how closely the schedule is being lived up to; in other words, whether the plant is being run efficiently or not. Moreover, such a balance is a history of the way the work went through the shop and is readily comparable with similar work done previously or subsequently, thus enabling us to form a definite idea as to whether the plant is being run more or less efficiently. The balance of work sheet then gives us a daily analysis of how the work is progressing, and in its graphical form is so easily read that both foremen and superintendents find it of great value. The man's record shows the efficiency of each man, and the two taken together give us the knowledge, in the clearest way, of what should be done to increase our output.

8. *Value of Balance not Dependent upon Method of Compensation.* It is not the intention of this paper to discuss the making

of schedules for doing work, or instruction cards for the workmen to follow, or indeed the subject of compensation for work done, for the keeping of a daily balance of work done and a record of the men doing it are invaluable, no matter what the method of compensation. In fact, the writer has found the man's record when work was done by the day to be of the highest value, for when the men realize that not only their chance for increase of wages, but that of holding their positions depends upon the amount and quality of their work, they become very much more efficient. Add to this the fact that efficient men paid in proportion to their efficiency are invariably better satisfied than less efficient, cheaper men, and we have an added reason for keeping the man's record. Again a workman easily forgets how many days he has been absent, and how much poor work he has done and an occasional glance at his record often does him a great deal of good. The writer first kept such a record in the foundry of the Midvale Steel Company thirteen years ago, and found it so valuable that he has always done it since when possible. Such record sheets are so easily gotten up and of so many kinds that the writer has not considered it necessary to illustrate them.

9. *The Graphical Balance and the Foreman.* Next to the superintendent the most overworked people in the ordinary manufacturing plant are the foremen. Their duties may be summed up as follows, in the order of their importance: to get their work out on time; to get it out economically; to improve their methods. Add to their primary duties a multitude of others depending upon them, and but little time is left for thought, or investigation, on which depends improvement. When they are rushed, therefore, improvement is naturally the first thing to suffer. Further pushing causes economy to be sacrificed, for the work must get out, and the foreman has not time to go over and over his orders to see just what is the most economical arrangement of his work. Here is where the graphical schedule comes to his assistance, for he can see at a glance just what is behind or what should be done next. There has been but little difficulty in getting foremen to recognize the value of such a balance, and I have yet to learn of one, who, having gotten such a sheet in full operation, was willing to give it up.

10. *Cost of Keeping Balances.* The question is frequently asked as to the cost of keeping these records and balances. In reply I have to say that if such cost were ten times what it is, it would cut no figure.

In day work we buy a man's time, and he frequently gives but little else. Our storekeeper checks exactly the materials we buy but nobody knows exactly what the day workman has done in his ten hours; although we know labor to be the most difficult commodity we have to buy, we give it the least systematic study, and my effort to get an exact record of what we get for our money is the first step toward purchasing it in an intelligent manner. With regard to the balance of work, I can only say that it is hard to estimate the cost of lack of harmony in a plant, and the increase in efficiency produced by getting materials in their proper order rather than according to the judgment of the various foremen is greater than is usually realized.

The fact that, as far as the writer's experience goes, the foremen are not only willing to use these graphical sheets, but are glad to do so in order to make their work harmonize with that of other departments, is the strongest proof of the value of the graphical over the other forms of balance.

The value of a balance of some sort is too well understood to need discussion, and the only reason that it has not been adopted is often the fancied cost of getting it. As a matter of fact, all I have suggested can usually be gotten by the ordinary time and cost keeping force with but little help, and frequently without any. It is so closely allied to the time and cost keeping that when all are done together by the best modern method, the reduction of labor in getting the time and cost often more than offsets the increase due to keeping the men's records and the balance of work. The method referred to is the time and production card system, of which the following is a description. There are conditions under which the system to be described here may be modified; in fact, it is not always found possible to introduce it exactly as described, which, however, is the ideal method of operating it and should be approximated as nearly as possible. It was first introduced substantially in this form

by Mr. Fred W. Taylor at the works of the Bethlehem Steel Company.

11. *Time and Production Card System.* In its best development, a card is assigned the day previous to every man who is expected in at 7 A.M. the next day. Each of these cards is stamped with a rubber stamp 7 A.M. and the date. These cards are placed in a rack, which has a properly numbered space for each man, who takes from it his own card and no other. Any men coming in after 7 A.M. are not allowed access to the rack, but must get their cards from the office, where the cards are marked properly by a time stamp with the exact time each man comes in.

Without any delay each man goes directly to the work that has been assigned to him, and, while his machine is running, fills in on the card his name, his number, the order number, the machine number and the kind of work he is doing. At the end of the day he enters on his card the number of pieces that have been correctly finished, and the card is signed by the foreman or inspector, certifying that all of the entries are correct. If there have been errors in the work the foreman or inspector does not sign the time card, but makes out a supplementary card stating the exact nature of the errors, etc., and pins this card to the time card.

At the end of the day, or at noon, the men are allowed access to the card racks as soon as the whistle has blown, and each man deposits his card in the proper pocket, an observer noting that a man deposits one card only.

Men coming in after noon get their cards in the same manner as in the morning; the cards being previously stamped with the hour work begins, and placed in the rack. Men who do not go out at noon do not need to change their cards.

When the men have gone out at the end of the day or at noon, the cards in the rack are stamped by means of a rubber stamp with the time the work ends.

The preferable form of card is a square one on paper stout enough to be shuffled. In the upper right-hand corner of the card should be placed the man's number, the order number and the machine number.

As there is room for one order number and one machine number only on one card, the workman must give in his card at the office and get a new one whenever he goes either on a new order or another machine.

12. *Time and Man's Record.* In order to get a record of the man's time and work for the day, all the cards bearing his number must be gotten together. If these do not give a total of the full number of working hours, the first card of the day must show that he was late, or there must be a pass stating what time he went out. These passes should be of the same size as the cards, and be put in with the time cards and sorted out by the man's number, so that when the clerk begins to enter the time and record he will have all the information at hand. The man's record may serve as a pay sheet, thus involving only one set of entries. When the time is entered up, the clerk doing it enters his initial in the lower left-hand corner in the space marked " pay sheet."

13. *Cost.* To get the cost on an order the cards are then sorted by " order number," and when the clerk begins to enter up the time or wages against any order, he should have before him all the cards representing work on that order. He is thus enabled to make the final entry directly from the cards, thus doing the work with a minimum of clerical labor. The clerk enters his initial in the space designated for such entry on " cost sheet."

14. *Progress or Production.* To get a record of the work on any order, the cards which have been sorted by order number are further sorted by name of part and operation. We thus get together the cards showing on an order the number of pieces on which a certain operation has been finished that day. These are added up and entered directly on the Production or Progress sheet. By this method we can keep an intelligible record of all the work done with a minimum of clerical labor.

15. *Difficulty of Getting a Daily Balance.* It is not necessary for the purpose I have in mind to dwell further on the details, my object being only to show that the difficulty of getting this daily record of our men and a balance of work done is not so great as to be prohibitory. In other words, it is an entirely feasible thing to know exactly all that has been done in a large plant one day

before noon of the next, and to get a complete balance of work in order to lay out that afternoon in a logical manner the work for the next day.

16. *Value of such a Balance.* The value of such a balance consists in the fact that it makes clear details that no observer, however keen he may be, can see by inspection. It shows us what work is behind and how much, and enables us to trace to its source the cause of any delay. The superintendent sees at a glance what he never could find out by observation or by asking questions. It shows him how efficiently a plant is being run and where the defects in operation are. In connection with the man's record, it is the most complete analysis we can make of the working of a plant, and the one that will help us most quickly to bring into their proper channels things that have been going haphazard. Such an analysis is far more important than an improved tool steel or a new set of piece-rates. It should be established before the introduction of either of these in order that we may have some means of measuring the gain made by their introduction, and it should remain after they are introduced to show that a forward step once taken is never retraced.

17. *Accounting and Operating.* In conclusion the writer wishes to say that it is his opinion that we can do nothing in a manufacturing plant that will go so far toward increasing the output or the economy of operation as obtaining this exact knowledge of what is being done. The cost of getting it is almost nothing, and the methods of operation need not be disturbed in the least until an accumulation of knowledge points out the best course to pursue.

By the adoption of the methods outlined the accounting department ceases to be simply a critic of the manufacturing, and becomes an active assistant to every foreman and to the superintendent. In other words, the accounts cease to be simply records of production, and become potent factors in helping the producing departments.

18. *The Bonus System a Form of Profit Sharing.* Having established these combined order, schedule, and production sheets, the next step is to pay a bonus to the head of each shop

based on the extent to which he adheres to the schedule as laid out. These sheets thus do for the foreman what the Instruction Card does for the individual, and the final result of the system is harmonious working and a high degree of efficiency, a portion of the profits of which goes directly to the individual in proportion as his efforts tend to maintain that efficiency. Carried out to its logical end, therefore, the Bonus System as described in my previous paper becomes practically one of profit sharing, in which each man gets his portion of the profits as soon as he earns it.

In this paper I have confined myself as nearly as possible to general principles, using specific cases simply as illustrations. These principles are capable of further development and may be worked out in detail to suit the needs of many forms of manufacture.

X. Use of Production Charts in a Machine Shop[1]

By E. H. Schell

The slogan of the machine shop of today is: "Production." Overhead charges are increasing; greater competition is lowering the margin of profits; and promptness in the filling of contracts is becoming more necessary. Present-day difficulties must be foreseen and not experienced, and should delays be encountered, their presence must be immediately explained, and the causes remedied. The most successful executives in the metal-working trades are demanding organizations which will place the details of their business, in clear and concise form, at their finger tips, so that they may be spared the work of investigation and occupy themselves more efficiently in authorizing improvements and creating higher economies.

To meet these requirements there have been developed the so-called production charts. These are veritable work pictures, and show at a glance the machines which are delaying factors in the manufacture of the piece under investigation. They also indicate the causes of soldiering and enforced idleness, and point

[1] *American Machinist*, August 21, 1913, pp. 307–309. Reprinted by permission of *American Machinist*. Illustrations of charts are omitted.

to the reason for hitherto unexplainable congestions of work in the shop.

Thus the foreman is relieved of vexing conditions which are, perhaps, beyond his control, and it is possible for the superintendent or factory manager to place unerringly the responsibility for the delays or high cost of production. The data necessary for the formation of these charts are easily obtainable, consisting of a list of the operations in sequence of the piece under investigation with the corresponding daily or hourly output of each machine engaged in the production. The machine output is then plotted [on cross-section paper] against the operations in sequence and the points connected.

It is evident that this graph [omitted] does not represent ideal conditions, for the hourly machine production grows gradually less as the work passes to its finished stage. To obtain the highest degree of efficiency, each machine should produce at an equal rate, and the line would be a straight one across the chart, parallel to the base line. Such a condition is met with in paper and cotton mills where the kind and quantity of the product to be manufactured is a known and constant quantity for which special machinery may be designed and installed.

In the machine shop, with its constantly varying product, we can only approximate this condition as closely as possible. Nevertheless, there is a certain advantage in the curve shown, in that this proportioning of machine capacities tends to develop small reserves of partially finished parts at various stages, as indicated by the cross-hatched portions. In this way, should one unit of production become disabled, the reserve following it could be drawn on and the output of finished parts continue.

Let us assume, however, that it is possible to reverse the order of operations during the advance of the work and that the machines increase instead of decrease in capacity. This is perhaps the most unfortunate condition that we find in the study of production charts. Here each machine has a slightly lower operating time than the one before it, but the difference is not sufficient to make it advisable to leave the line of operation and engage temporarily in other work.

This condition becomes more aggravated as the piece nears completion, the enforced idleness here being additive as indicated by a cross-hatched portion. The employees will tend to conceal this enforced idleness by soldiering of various sorts, realizing the uselessness of "breaking up" and working temporarily on other work. How many foremen have been puzzled by this steady refusal to hasten production on the part of the operator, and have had to endure the blame for delays which they could not seem to rectify?

A specific example may make this point clearer. Supposing the machines to be adjacent to one another so that the work is passed along in lots of four or five. Assume that 1000 levers are to be operated upon. The first operation is completed in approximately 31 hours, the second in 32, the third in 33½ and so on until the parts are completed, with a sum total of about 315 hours. It is evident that as each machine completes its operation it is at liberty to be readjusted and engaged in other work.

Let us now consider the operations in reverse order. Here, each machine must work at the rate imposed by the first in line, for this is the weakest link in the chain of operations, requiring 40 hours to complete the task. Consequently, a total of 360 hours is spent in operating upon the levers, showing a loss in time of 46½ hours over the other sequence, although the machines used are identical.

This illustration may appear much exaggerated, but it should be remembered that the operators engaged in work of this type are not usually side by side, and the consignment of parts is divided into lots of 50 or 75 to minimize trucking, with the result that, while the trouble is just as influential as before, its presence is not nearly so obvious to the worried foreman who has other details on his mind.

It is evident, therefore, that in the assignment of operations to any given part, it is imperative that, should the productive capacity of the machines fluctuate at all, the variation should be in a decreasing scale as the operations proceed. This rule applies only to parts in which there are no abrupt changes in the capacity

of the machines. For example, when it is found necessary to pass from one unit of very high daily output to one of low production, temporary storage may be made use of and the high-duty machine allowed to complete a continuous run, the next operator drawing upon the stored reserve.

If the situation is reversed, and very low production precedes a possible high daily output, the high-duty machine may be utilized profitably for other purposes over a certain interval, and operate upon the work at hand after a sufficient quantity of it has accumulated. The following illustration will perhaps best show the great effect which individual conditions and circumstances have upon the development of an efficient production chart.

Attention was recently called to a certain machine shop whose floors were crowded with a certain cylinder casting in various stages of completion. While investigating the cause, a production chart was made. The number of cylinders in reserve between each operation was next obtained and indicated by a dotted line. The startling way in which this line lagged behind the production curve showed at once that the great inequalities in the machine capacities, as well as the arrangement of the operations were, in large measure, responsible for the congestion.

As is the case in all revisions of production charts, the possibility of altering the sequence of operations was first considered with the aim of developing, as nearly as possible, a series of level or down-sloping portions connected by steeper slopes.

The dotted line beneath the peak of the third operation indicates that the multiple drill which is here employed may be operated only enough each day to complete the daily product required by the next machine. Between the fifth and sixth and the seventh and eighth operations, storage space was suggested, thus allowing the highly productive factors to complete the lot at once and become otherwise available. The last two operators having large daily output, the variation is sufficient to allow them to spend a portion of each day upon other work.

A study of the various jigs, fixtures, machine tools and methods of operation indicated that a [desired] production line was not unattainable, and in this way the entire problem was analyzed

and placed in clear, understandable form, the difficulties made evident, the delays and congestions explained, and the remedies suggested.

Only a few of the possibilities which these charts exhibit, and the uses to which they may be put in developing and formulating new and more economical methods of manufacturing, have been touched upon. Their great value in the visualizing of machine-shop production leads to the belief that their development and use will constitute a well-defined departmental activity in the manufacturing organizations of the future.

XI. Aids to Scientific Foundry Management [1]

By W. M. Corse

One of the first steps in the scientific management of a plant is to plan a proper organization. This gives everyone a base on which to start and clarifies the atmosphere of petty jealousies and misunderstandings. With this organization chart before us we can follow out the various departments and finally perfect a harmonious working people.

My own plan is to start a system of factory records in order that the management may have written information of the happenings in the shop at the present time and a record for the future. These may be daily, weekly or monthly reports and should serve to furnish information that will give a mental picture of affairs in a concise manner. These records should be immediate, adequate and permanent.

I shall attempt to describe some of the records I have used with success in a brass factory. I do not say that these are all that are needed, or that better cannot be found for special cases, but simply that those mentioned will aid the manager to see more clearly the conditions with which he has to contend daily.

The first and most difficult report to keep accurately is that of the metal melted and of the output. We may call it the metal report or practice sheet. To secure positive results it is wise to have a separate room in which to store the daily supply of metal

[1] *Iron Age*, March 13, 1913, pp. 688–689. Reprinted by permission of author and of *Iron Age*. Illustrations of forms are omitted.

for the various mixtures and the shop scrap from each alloy produced. These should be kept in separate bins or boxes, properly marked with the alloy number, so that errors in weighing can be minimized. As many alloys look similar in outward appearance, great care should be exercised first in taking the castings from the foundry to the cleaning room and next in taking the gates and risers and defective castings from the cleaning room and inspection departments. In this case, as in all movements of goods in process, the arrangement of the various departments should be such that the metal moves in a direction that does not cross or back-track other material. The tagging of alloys that cannot be readily picked out by their appearance will aid materially in keeping this record accurate. The progressive jobbing foundry will frequently have twenty-five standard alloys, as well as a large number of special mixtures.

Let us follow the process of the metal and note the steps in that process. First, the storekeeper weighs out the bulk metals to the foundry metal room, receiving in return a signed requisition from the weighmaster. This requisition serves as a check on the store records and aids the purchasing department in balancing the materials account with the accounting department at the end of the month. Second, the weighmaster weighs out the various amounts of new metals and shop scrap for the mixtures ordered by the furnace department, using the daily working formulae given to him by the metallurgist in charge of the laboratory. Before delivering the mixtures to the furnace department, the weighmaster should record, on a special ruled sheet, the alloy number, furnace number and the weights of the constituent metals. At the end of the day this sheet goes to the metallurgist to be checked and from there to the cost office for compilation. The totals of these daily sheets for a week give the amount of each alloy charged to the furnace department and when credited with the amount remaining at the end of the week show the metal melted for that period. They show not only the amount of the various constituents used in each alloy, but also the total of each metal used for the week. They further show exactly what each furnace is producing.

This information can be used for determining the consumption of metal and gives the purchasing department an accurate figure on which to base future purchases for the maintenance of sufficient stock for the orders on hand. It would hardly seem necessary to draw attention to this record, but I have often been surprised to find that no such information is available in many large foundries.

We now have figures on our weekly summary sheet which may be said to constitute the debit side of the account. The credit side of the account consists of the output of the foundry divided into ingot metal, good castings, bad castings, gates, risers and recovered metal. They are weighed by the inspection department, the first three coming from the inspection department itself, the fourth from the cleaning room and the fifth from the recovery department. They are separated first by day's work, then by alloys. Subtracting the output of each alloy from the metal charged to the furnace department will give the gross loss of each mixture and the difference of the totals the gross loss of the foundry for the work.

The net loss is figured at the end of any period by assaying recovered metal too fine to be returned direct to the foundry, from the metal recovery department, figuring the weight of metal recovered and subtracting it from the gross loss. For cost purposes the net loss by weight cannot be used because the recovered metal cannot be sold for its full value to the smelter. We therefore estimate the value of the metal melted for the period in question, divide it into the amount received from the smelter for the recovered metal, thus arriving at the percentage of the recovered metal. This is subtracted from the gross percentage loss to be added to the formula cost of the alloy. This is not strictly accurate in that the gross percentage loss by weight may not represent the formula cost of the new metal, but as the more volatile metals are usually the cheaper, the error is on the safe side.

Let us take an example: The new metal may consist of 85 parts of copper, 5 parts tin, 5 parts lead and 5 parts zinc. This would cost on the basis of 50-cent tin, 4½-cent lead, 15-cent copper and 7-cent zinc, about 15.82 cents a pound. If we are making ingot

metal, we would add the approximate net loss of 3 per cent, determined as outlined above, or 0.47 cents to 15.82 cents, giving us 16.29 cents as the cost of the metals constituting the alloy.

The fact that such a figure does not give the cost of the alloy in the castings is frequently overlooked in cost accounting. Let us see why these figures cannot be used in estimating cost of castings. If we melt 100 pounds of metal we may assume in ordinary brass foundry practice that we will net about 45 pounds of good castings. It is apparent that 100 pounds of metal costs in the formula 15.82 cents per pound and that we lose 3 pounds valued at 0.47 cent. Therefore, 45 pounds of good castings would cost 45 × 15.82 cents or $7.13. Figuring the loss on the value of the good castings we get 0.47 ÷ 7.13 or 6.6 per cent. The metal in the castings, therefore, costs 15.82 + (6.6 per cent of 15.82) or 15.82 + 1.04 = 16.86 cents per pound.

An easy way to determine the amount to be added for loss is to divide 100 by the percentage of good castings produced, in this case 45 per cent, giving a factor of 2.2. Multiplying the net loss of 3 per cent by the factor 2.2 we get 6.6 per cent, which is the same as we determined by the other method. We now have found, by the use of the metal report or metal practice sheet, a means of checking the store records, the amount of metal melted, the output and the factors to be used in figuring the value of the metal for cost purposes.

You will agree that these are all essential figures and also that we have determined one of the three elements of any cost, namely, material. The other two elements, labor and expenses, are determined by any of the accepted methods of cost accounting.

The second record of importance is the daily casting report. The first essential for this report is to have every day's work kept absolutely separate in all departments handling the castings, except the shipping room. There are many advantages in keeping the day's work separate, which pay for the extra labor involved. As soon as the castings are shaken out, they are checked for count and customer's name by the foundry clerk and sent to the cleaning room. This record is made in duplicate in the left-hand columns of the report and a copy goes to the production clerk,

who records the number of the pieces made on the shop order, which is a copy of the customer's original order. This in turn enables the production department to keep in close touch with the orders in process.

As the castings come from the cleaning room, they are examined in the inspection department and the weight and count of good and bad pieces noted. The good castings pass directly to the shipping department; while the defective pieces are sorted by pattern number and by molders' numbers, on a bench set apart for that purpose. When the day's work is all inspected, the foundry superintendent and factory engineer go over each lot of defectives and note the causes of defect. This serves to furnish information for the immediate correction of excessive losses. We all know that one of the big leaks in any foundry is the amount of bad castings, so that the relatively small amount of time spent in their examination will surely lead to large savings. It is surprising how frequently this examination is casual, instead of systematic, and it generally needs a cost record to emphasize the amount of the loss through defective castings before much attention is paid to this feature. A bonus paid to the foremen, when the percentage of defectives drops below a stated amount, will often stimulate interest in this matter.

The inspection department records the number and weight of the good and bad pieces opposite the count noted by the foundry clerk on the daily casting report and the percentage of defectives, by pieces, is calculated. This report is arranged by molders' numbers so that it will show the foundry superintendent and factory engineer the quality of work being turned out by each molder. A compilation of the daily reports for the week will show the percentage of loss by each molder, and the weight of castings produced. The latter when divided by the number of working hours will show the number of pounds produced per molder per day for the week. This serves as an excellent check on each molder's efficiency.

Another compilation will show the total castings produced per alloy by weight and pieces and also the total weight and pieces for the week. This is the source of part of the information regard-

ing output which was mentioned under the metal report in the first part of the paper. From the total weight and pieces is figured the average weight of the castings produced and the total defective loss in percentage by weight and pieces. This gives a good general idea of the efficiency of the foundry department when taken in connection with average number of pounds produced per molder per day.

You will see that a careful study of the reports as described will give a good general view of the conditions in the foundry. If one wishes, the results may be plotted on a graphic chart which will show these conditions at a glance more effectively than a report consisting of the figures only.

When a job is of sufficient length to make it advisable the record of the defectives may be kept on cards arranged by pattern numbers. The average of a period points out the excessive defects and indicates the patterns to be improved immediately, in order to gain maximum benefits.

The third set of records that I might mention are the individual cards showing the exact time spent on each job. On these cards are entered the weight and count taken from the daily casting reports, thus giving a complete record of the job to be used as a basis for figuring its cost. The various items of expense chargeable to each job are taken from the expense analysis of the month preceding. This expense analysis is made up from the payroll, which has been subdivided by job or standing plant order numbers, and the various items of expense are taken from the storeroom requisitions and the voucher register in the accounting department.

To summarize, we have the sources of information for the three items of cost, viz., material, labor and expense.

1. The metal report which gives the cost of material.

2. The individual cost cards which give the labor on each job.

3. The expense analysis which gives the items of expense chargeable to each hour of productive labor on each pound of castings produced, depending on which method is followed in figuring the expense in the department in question.

In order to manage any business scientifically the basic facts which underlie it must be known. As a step in this direction, the reports mentioned above will serve to give fairly complete information. Many others can be added to give specific information, such as figuring piecework rates and standard time and bonus rates, but these should, in my opinion, follow those first mentioned.

I have tried to outline the use to be made of a few principal reports with a view of stimulating interest in securing accurate information. It is only by this means, I believe, that the so-called scientific management can be introduced in a foundry. After a year or two the more complex methods of pay and performance can be added, but I think the mistake may be made of trying to introduce too much at first, thus causing confusion and distrust on the part of all who should reap the most benefit from a perfected system of cost and efficiency.

XII. Manufacturing Expense [1]

By Nicholas T. Ficker

A shop cost is made up of three component parts: labor, material, and manufacturing expense. The most important of these is manufacturing expense. It derives its importance not alone from its magnitude as a component part but also through what might justly be called its elusiveness. Labor and material are quantities which are easily determined, but the correct distribution and apportionment of manufacturing expense so that each job passing through the factory may bear its true share is a matter requiring the most careful analysis and study. When we stop to consider that, in a large percentage of the two hundred and fifty thousand or more factories in the United States, this manufacturing expense amounts to more than the combined total of the productive labor and material used, an idea of its importance will be readily comprehended.

[1] *Engineering Magazine*, June, 1915, pp. 321–326; July, 1915, pp. 553–559. Reprinted by permission of *Engineering Magazine*.

Probably the most common practice of distributing manufacturing expense is that of taking the total of this expense for the previous year and determining what percentage this total bears to the productive labor for that period, and then applying this percentage to each job on the basis of the productive labor which has been charged directly to these jobs. Except in rare instances, where the monthly output is practically uniform and where the article made consists of only one item of merchandise, this method of applying manufacturing expense is of no value whatever. Even in such a case as has just been cited it would not be correct to distribute the expense on the basis of productive labor, where this productive labor consists of both daywork and piecework labor.

Let us take for example a factory employing one hundred people in five manufacturing departments, and assume that the class of merchandise manufactured is brass fittings of which there are two dozen different articles. In looking over his books for the preceding year the manufacturer finds that his productive labor amounted to $100,000 and his manufacturing expense to $50,000. He reasons, therefore, that if he adds fifty cents to every dollar of productive labor applied on jobs passing through his factory during the ensuing year, he will have a fairly accurate idea of what it costs him to manufacture each job. He therefore issues an order to his cost department to compile costs for the ensuing year on that basis, and then feels that he has solved the whole problem of cost finding on any of his two dozen different articles of manufacture and has established a correct basis for estimating and billing purposes. Let us now see how near he is to his real costs of production. The factory is divided into five different departments as follows: —

Department	Number of Employees	Productive Labor
Lathe	15	$9,000.00
Milling	15	18,000.00
Drilling	20	18,000.00
Punch Press	5	5,000.00
Assembly	45	50,000.00
Total	100	$100,000.00

A detailed analysis of manufacturing expense,[1] consisting of charges for administration, power, rent, light, tool expense, depreciation, insurance, taxes, sundry and material expense, showed that the manufacturing expense should have been divided as follows: —

Department	Manufacturing Expense	Productive Labor
Lathe	$6,000.00	67%
Milling	15,000.00	83
Drilling	9,000.00	50
Punch Press	10,000.00	200
Assembly	10,000.00	20
Total	$50,000.00	50%

This analysis shows a wide variation between the relation of the manufacturing expense and the productive labor of the various departments. The Drilling Department alone shows a percentage on which it would be safe to apply the 50 per cent charge for

Department	Productive Labor	Manufacturing Expense	Percentage of Mfg. Expense to Productive Labor	Departmental Mfg. Expense based on 50 per cent rate	Error of Unit Costs by using one general rate for all departments
Lathe	$9,000	$6,000	67%	$4,500	− $1,500
Milling	18,000	15,000	83	9,000	− 6,000
Drilling	18,000	9,000	50	9,000	....
Punch Press	5,000	10,000	200	2,500	− 7,500
Assembly	50,000	10,000	20	25,000	+ 15,000
Total	$100,000	$50,000	50%	$50,000	....

manufacturing expense; the variations in the other four departments showing a discrepancy of from 20 to 150 per cent.

A study of the comparative table above will show this variation very clearly. It will be seen, for example, that the actual manufacturing expense of the Punch Press Department is 200 per cent of the productive labor; therefore, by applying the general rate of 50 per cent, which the manufacturer decided

[1] Numerous cost accountants include interest as a manufacturing expense. Because of the great differences in the investment in different machines, as well as for other reasons, the editor believes that interest should be included. [Editor.]

at the beginning of the year to apply to all departments, the costs of production in the Punch Press Department are found to be $7,500 too low. In like manner the costs of the Assembly Department are $15,000 too high, due to the fact that the manufacturing expense in this department is actually only 20 per cent of the productive labor.

Percentages cannot be averaged when they are based on different units. The error of assuming that they do average is committed constantly by even some of the largest and most efficient manufacturers. The average manufacturer, after a presentation of errors similar to those which have just been cited, will say, "Very true — but, what difference does it make even if my departmental expense charges are wrong, so long as they average out in the final completed cost?" This would be a poser to reply to providing his assumption were correct. His whole basis of reasoning however is wrong, for the simple reason that he has failed to grasp one of the fundamental laws of mathematics and has labored under the delusion that a minus percentage in one department would be offset and equalized by a plus percentage in another department. The road to bankruptcy is strewn with the wrecks of just such men who failed to appreciate until too late this very simple but yet most important principle. A concrete illustration of just how errors of this kind are made each day would probably be of interest at this point. Let us assume that a certain order has just been completed after passing through all of the departments of the shop, and is now ready to be figured.

The time tickets show that forty-two hours were spent on this job. For simplicity let us assume a uniform rate of twenty cents an hour. An analysis of these time tickets by departments will then show the work to have been divided up as follows: —

Department	Time	Rate	Labor Cost
Lathe	2	$0.20	$0.40
Milling	4	"	0.80
Drilling	6	"	1.20
Punch Press	10	"	2.00
Assembly	20	"	4.00
Total	42	"	$8.40

Adding to the above labor the standard manufacturing expense rate of 50 per cent which the manufacturer decided was to be applied to all jobs irrespective of the department, and considering the material cost as $1.00, this job would then show a total cost of $13.60 made up as follows: —

Labor	$8.40
Manufacturing Expense	4.20
Material	1.00
Total	$13.60

We have found by analysis, however, that each of the departments through which this job passed in the process of manufacture had a different rate of manufacturing expense. Taking the actual percentage of manufacturing expense for each department and compiling the shop cost of each job by figuring this expense separately, we find a considerable variation existing between the cost as compiled on the 50 per cent basis for all departments and that compiled by considering the work of each department independently. The cost figures would appear as follows: —

Department	Labor	Mfg. Expense		
Lathe	$0.40	67%	=	$0.27
Milling	0.80	83	=	0.68
Drilling	1.20	50	=	0.60
Punch Press	2.00	200	=	4.00
Assembly	4.00	20	=	0.80
Total	$8.40			$6.35

The manufacturing expense, therefore, which should have been applied against the labor on this job amounts to $6.35 instead of $4.20, making an error of $2.15. This shows that the manufacturing expense which had really been applied was approximately only two-thirds of the actual figure. The corrected cost would show: —

Labor	$8.40
Manufacturing Expense	6.35
Material	1.00
Total	$15.75

Assuming that the manufactured product had a highly competitive selling field and that the percentage of profit which the manufacturer could add to his cost of $13.60 was limited to 10 per cent, then the actual billing price of $14.96, as based on his 50 per cent manufacturing expense, would, instead of netting him a profit of $1.36, net him an actual loss of $0.79. Or, looking at it from another angle, let us assume that this article had a market price of $15.50 and that, irrespective of the cost of manufacture, this price was the limit his customers would pay, then the manufacturer would still imagine that he was making a profit of $1.90 or close on to 14 per cent on his investment of $13.60, when in reality he was losing $0.25 on each of these articles he sold.

The question which the student of this subject will most naturally ask at this point will be, " What if he does lose money on this article as long as he is making enough profit on some of his other lines to more than make up for this loss ? " He may also ask, " What is the manufacturer to do, if he is forced to make an article or line on which he is losing money, in order to keep all of his lines intact ? "

A farmer who raises chickens and does not occasionally take count of his stock will not discover until probably too late that some thieving fox has been preying on those chickens; but once let him know that such a condition exists and he will lie in wait night after night with a shotgun until the cause of trouble has been removed. This is analogous to the manufacturer in the above case; as long as he is not aware of the losses which are occurring he will be satisfied to a certain extent and will not investigate, but once let him know that it is actually costing him more to make than he can sell for and the fur will usually start to fly very quickly. An article which is being sold at less than his manufacturing cost usually means that some other manufacturer is turning out this article at a much lower cost than he is. This means investigating methods, locating leaks, and exercising a close watch and supervision over this line until the cause of trouble has been remedied. Very often it may even be found advantageous to discontinue that line, but the

factor of paramount importance is in finding where the trouble exists.

There is also another phase of this matter which is worthy of consideration at this point. The very fact that a manufacturer is losing money on some lines and is still able to show a substantial profit at the close of each year's business means that he is making an abnormal profit on one or more of his other lines. By substantially reducing his selling prices on one or more of these lines showing such an abnormal profit it may be possible for him to monopolize all the business in that line, his increase in sales more than making up for the small profit per unit sold.

Shop costs when compiled on the hit and miss principle of using one general rate for manufacturing expense, applicable to all departments and classes of work, are therefore of very little value except in very rare cases, such as that cited at the beginning of this chapter where the output is of the mass production style on a single type of merchandise.

Manufacturing expense might justly be termed a function of time. It increases in a ratio which is practically directly proportional to time. Administration, rent, depreciation, taxes, power, and other charges which make up the manufacturing expense, with the possible exception of that part known as material expense, are all proportionate thereto. In using the productive labor as a basis of expense distribution, it must be thoroughly understood that only when such labor is used as a function of time is it permissible to use it as a basis for distributing manufacturing expense.

Manufacturers and cost accountants very often make the mistake of using the productive labor as a basis when a large amount of this labor is piecework. Even where the expenses have been segregated by departments, the introduction of piecework labor will change the entire aspect of the case. Piecework is not a function of time, it is a function of quantity; and as manufacturing expense, when not split up into two divisions (machine expense and material expense) and applied as two separate items to shop costs, cannot be distributed correctly on any basis but that of time or functions of time, piecework labor cannot be

used as a basis for distribution. It is not to be understood from the foregoing that even where the material expense is added to shop costs as a separate item is it permissible to use piecework labor for distributing manufacturing expense. The method of applying this material expense will be taken up in a later paragraph and explained in detail.

To illustrate more fully the error of using piecework labor as a basis of expense distribution, let us take, for example, a department in which a certain manufacturing expense rate has been figured on the basis of straight daywork labor. At a punch-press machine in this department a man is getting paid at the rate of twenty-five cents an hour. By analysis of the cost of certain punched parts, it was found that the operator punched out these parts at a rate of 2,500 an hour and a piecework rate of one cent a hundred was set for all work on this piece of merchandise, this being equivalent to his hourly rate of twenty-five cents. Let us further assume that the departmental rate of, say 60 per cent of the productive labor, fairly accurately represents the expense of operating this punch press. This would mean that a charge of fifteen cents an hour (60 per cent of twenty-five cents) would cover the cost of the manufacturing expense which this machine must bear of the department's total charge. Piecework is introduced at this point. The pressman, spurred on by the incentive of higher wages, speeds up his production to such an extent that instead of turning out 2,500 pieces an hour he actually increases this to 4,000 pieces. At the rate of one cent a hundred, his pay, therefore, amounts to forty cents an hour instead of the twenty-five cents which he earned on an hourly basis. In course of due time the cost clerk who figures this job applies his 60 per cent to the forty cent labor charge, making the manufacturing expense chargeable against this job twenty-four cents. But if this pressman had turned out 4,000 pieces an hour while on a straight daywork rate of twenty-five cents an hour, the clerk would have added only fifteen cents for manufacturing expense instead of twenty-four cents under the piecework arrangement; this makes a difference of nine cents in the manufacturing expense charge or, in percentage, a variation of 60 per cent over the original method of determining this expense.

The only way to determine which of these two methods is correct is to find whether or not these charges actually did increase 60 per cent on an increased production due to the piecework method. Administration, rent, light, depreciation, insurance, taxes, and tool charges remain the same regardless of the value of output; all that remains of the items which enter into the manufacturing expense are power and material expense, and the very small increase in either or both of these items would be so small as to hardly make them worthy of consideration. Piecework cannot, therefore, be used as a basis for manufacturing expense distributing. The labor must be reduced to functions of time or else be figured directly on the basis of time. In order to determine correctly the manufacturing expense on the job above referred to the cost clerk must know the time it has taken the pressman to stamp out the 4,000 pieces and, finding this to be one hour, he applies his standard rate of manufacturing expense for that department, which is 60 per cent of the productive labor, to the twenty-five cent labor charge and finds the charge for manufacturing expense against this job to be fifteen cents.

Manufacturers commonly commit the error of discontinuing time-keeping on jobs after piecework rates have once been established. The importance of timing all jobs will be appreciated by simply keeping in mind the fact that the unit of time must be used as a basis for distributing the manufacturing expense. In some of the larger manufacturing establishments where the piecework labor amounts to 80 per cent or more of the total productive labor, the time spent on each operation is known to a small fraction of an hour. By this means only can a reasonably sure basis be established for the distribution of manufacturing expense.

The purpose of this opening chapter has been to impress on the mind of the reader the necessity for segregating all of this expense by manufacturing departments, to establish the unit of time as a basis for such distribution, and to point out some of the mistakes that are made where a thorough knowledge of the subject is lacking. It will be seen, as a deeper insight into manufacturing expense distribution is gained, that a much finer segregation is

possible than that by departments which has been used as a basis of discussion in this chapter. The most important point to be comprehended at this time is that none of these finer distinctions are possible until after the primary stages are put into operation.

Many accountants make the mistake of thinking they can hurdle these primary stages and start right in on a segregation of expense by machines without first proving their distribution by departments as herein outlined. Nothing is to be gained by such methods of procedure as they invariably result in disaster to the entire scheme. The first requirement is to establish to a satisfactory degree of certainty a basis that is correct; then each successive step will become simply a matter of careful analysis.

The Two Main Divisions: Machine Expense and Material Expense

Before going into a detailed analysis of the various elements comprising manufacturing expense, it is of paramount importance that a thorough understanding be had of just what is included by the term.

A manufacturing establishment may be roughly divided up into three main divisions of organizations: (1) the manufacturing or shop organization; (2) the sales organization; and (3) the general organization. The sales organization, which is self-explanatory, and the general organization, which consists of the general executive officers of the company and their staffs, may be eliminated from this discussion. We are simply concerned with what is known as the manufacturing or shop organization and the expense incidental thereto. Whenever the term "manufacturing expense" is used in this discussion it should be understood to refer only to the shop proper and not to any other organization of the company.

Manufacturing expense may be defined as consisting of all charges incurred in connection with manufacturing which are not considered as productive labor or raw material. It is made up of two kinds of expense — machine expense and material expense. These two divisions of manufacturing expense require distribution

to jobs according to different methods. Machine expense, for example, is distributable on the basis of time while material expense is proportional to the bulk of the raw material used.

In classifying expense items, however, it is extremely difficult, if not impossible, to charge expenses directly against either machine expense or material expense with any degree of accuracy. This can be illustrated by considering the expense charge for light, which forms part of what we shall later denote as rent expense. The expense of lighting the material stockrooms, for instance, would be classified "material expense," while the expense of lighting the manufacturing departments would be classified "machine expense." From this example it can be seen that it would be practically impossible for the clerk who does the classifying to prorate an expense charge for light so that the two main divisions of manufacturing expense would receive their just allotment. Therefore, in order to simplify the work of classification, all expense items are first charged to one or more of the classes listed below and then closed out at periodic intervals into either machine expense or material expense according to certain fixed rules which will be discussed later. These classes of expense are as follows: —

Administration Expense		
Power "		
Rent "		
Tool "		
Fixed Charges: —		
Depreciation "		Closed out into Machine Expense and Material Expense
Insurance "		
Taxes "		
Idle Labor "		
Unclassified "		
Direct charges to Material Expense.[1]		

Whenever charges are made against any of the above classes a further sub-classification by departments and kinds of expense should be made. For example, a charge for "Repairs to a Punch and Die" would be classified Tool Expense, Repairs to Tools, Punch Press Department. Symbols denoting these classifica-

[1] Includes only expense pertaining to material.

tions are used to save time. Thus, the foregoing example might be classified as follows: —

25—032—525

in which 25 is the general ledger account number for manufacturing expense; 032, the sub-classification denoting "Repairs to Tools," and 525, the number of the department incurring the charge. In this manner a large part of the manufacturing expense can be readily segregated by departments. There are, however, some expenses which cannot be charged directly to specific manufacturing departments. These require distribution according to certain fixed rules: for example, administration expense, against which the salary of the general superintendent is chargeable, could not be assessed directly against any one department; it is, therefore, simply charged in blanket form to administration expense and then later it is prorated amongst the various departments on the basis of the number of employees in each. A shop superintendent does not superintend floor space or machines, but he does superintend the personnel of each department, therefore his salary and the salaries of his general staff are chargeable to the various manufacturing departments on the basis of the normal employees in each department. On the other hand, rent expense is distributed on the basis of floor space occupied by each department; power expense on the basis of kilowatt-hours consumed; and fixed charges on the basis of face values of equipment in each department.

Non-productive labor, such as wages of sweepers, material porters, freight elevator operators, watchmen, etc., requires classification to one or more of the several main divisions of expense which have been listed, and are finally absorbed in the departmental expense charges through the distribution of these main divisions of expense. For example, the wages of sweepers are chargeable to rent expense, and eventually are absorbed by the manufacturing departments through the rent charge which is assessed against all departments, storerooms, etc., on the basis of the number of square feet occupied by each. This charge per square foot is determined by simply applying the total of all charges included in rent expense against the total manufacturing

area and then reducing it to a charge per square foot. In like manner, wages of firemen are chargeable to power expense, and are distributed, together with other power expense items, on the basis of a rate per kilowatt-hour according to the power consumption of the various departments and divisions of the factory.

It is not the intention at this point to go very deeply into an analysis of all the sub-classifications to the several main expense divisions, which will be discussed more fully in a following chapter, but to lay particular stress upon the importance of correctly classifying all accounts which in any way affect the distribution of manufacturing expense.

In the opinion of the writer the division of expense that deserves to rank as most important is that classified as "idle labor expense." For some reason or other, however, those factors most deserving of consideration in a manufacturing establishment are the ones most apt to be neglected by the management. This statement is not made on hearsay, but is the conclusion forced upon the writer by association with conditions as they actually exist in many plants throughout the country. It is especially true of the manner in which control is exercised over the labor actually engaged in producing. All that the average factory manager seems to be interested in is in knowing that his employees are at their benches or machines when the whistle blows in the morning, that they stay there except during the lunch period until the whistle blows at night, and that some sort of distribution is made of the time consumed on the different jobs during this period. How much time has been wasted during the course of each day does not seem to be of particular interest to him. Ask the average manufacturer how much time his men waste in waiting for new jobs, how much time they waste waiting for tools, how much time they waste reporting to time clerks at the start and completion of each job. If he is honest he will tell you that he doesn't know. He may also tell you that all the time of his productive employees is distributed on jobs. Surely, there is nothing simpler than to charge every minute of the day to the five or ten jobs a man may have worked on during that time. However, the facts remain.

Let us take, for example, a factory employing a hundred workmen in the manufacturing departments at an average wage of twenty-five cents an hour. We will assume that the factory day is nine hours long, and that the average number of job changes is six a day. At the start and finish of each of these six jobs every employee reports to a timekeeper who, by the use of a time stamp, records the time of starting and finishing each job. There are two time clerks in the shop to handle the time of a hundred men. They are as centrally located as possible, but by timing the men, without their knowledge, it is found that it takes a man an average of two minutes going and two minutes coming back from the timekeepers' desk at the start and completion of each job he works on during the day. (This figure is very conservative and can be substantiated in almost any factory engaged in work requiring successive job changes.) We find, therefore, a loss of four minutes for each job or twenty-four minutes a day for each employee. This means two thousand four hundred minutes or forty hours a day for the entire force; at twenty-five cents an hour it is equivalent to $10.00 per day; for a year of three hundred working days it means a direct loss of $3,000. There are methods whereby the time is recorded right from the workmen's benches or machines that work out very satisfactorily, and do not require the men to leave their places at any time. This will answer the question of how job records are to be kept without necessitating the above loss of time.

Then, in addition to this $3,000 waste, there is the time consumed in waiting for the next job which, through faulty planning, has not arrived on schedule. These " waits " average anywhere from five minutes to half an hour, depending on how much interest the management shows in this part of the routine. In any event a loss of half an hour a day for each man would be extremely low and could hardly be criticized as being harsh on the management in view of present-day conditions. This means another loss that amounts to fifty hours, or $12.50 a day, or $3,750 a year. A total loss of $6,750, therefore, exists in comparison with a payroll of $67,500 for the year. This means that, without taking any other than these two causes of loss into con-

sideration, there is a charge right here of $6,750 to manufacturing expense, which must be distributed and absorbed by the output of the factory. It is, nevertheless, worthy of note that efficiency engineers, cost accountants, and managers of factories usually neglect to take this factor of idle time into consideration from a strictly labor cost point of view. Much has been written dealing with methods of applying the undistributed portion of manufacturing expense to costs of production where a balance has accumulated due to a decrease in shop activity, but for some unaccountable reason the expense incurred in the form of productive labor not engaged in producing has been disregarded.

The importance of knowing, therefore, what the machine activity is for the shop as a whole and for each department thereof becomes even more apparent when the fact is realized that the other manufacturing expense items, such as administration, power, rent, depreciation, insurance taxes, etc., have also been undistributed on production orders during the period measured by the "idle productive labor" just referred to.

A machine standing idle is still occupying floor space (rent expense), is still incurring tax and insurance charges, is still piling up power charges through the running of idlers, countershafting, etc., is still depreciating in value more than if it were in operation, and the administration expense is still being charged against the operator of that machine whether he is producing or not. Therefore for every minute that is charged to "idle productive labor" and which represents a loss in cold cash to the manufacturer, a certain additional amount for the manufacturing expense incurred during that period is also chargeable. The amount in dollars and cents, which the sum of these two sources of loss represents, is the measure of the loss which the manufacturer is really forced to stand. A careful consideration of the facts as presented cannot help but force the conclusion that "idle productive labor" is a very important factor in connection with the distribution of manufacturing expense. However, once its importance is realized, it is a comparatively simple matter to apply a remedy. Leaks of any nature in a manufacturing establishment derive their importance not so much from their occurrence

as from a lack of knowledge as to their existence. To know is to remedy, but the simplicity of the remedy has no bearing on the case providing the need of its application remains undiscovered.

Much has been written dealing with the routing and scheduling of shop orders, and with stock-keeping methods in general. The purpose here is not to discuss this phase of manufacturing in any way except to point out that a proper method for handling, routing, and scheduling production orders is essential, if a control over this important factor of expense, called "idle productive labor," is to be exercised.

Another important division of manufacturing expense is that classified as "material expense." Material expense may be defined as that expense incurred in purchasing, receiving, and handling shop, raw, and worked materials. It includes such expenses as depreciation, insurance, and taxes on raw and worked materials, salaries of raw and process material stockkeepers, counters, inspectors and porters, freight elevator operators (in part), etc. In shops where large cranes are used, it also includes the salaries of crane-men.

All manufacturing expense which is not chargeable as material expense is known as "machine expense." Where accurate costs are required material expense should be applied to shop costs as a separate item, that is, it should not be included with the machine expense as one general loading but considered separately. In such cases it should be applied as an individual rate, called material expense, on the basis of the value of the raw material charged against an order, or on the basis of the bulk (represented by weight) of the material used. The construction of a shop cost made up in this manner is here shown: —

Productive Labor
Machine Expense)
Raw Material → (Manufacturing Expense)
Material Expense)
___
Shop Cost

The practice of subdividing manufacturing expense into machine expense and material expense respectively has for its object a more perfect control over the channels through which

this expense accumulates than is possible where this segregation is not made. When classifying expense charges, it necessitates very little extra effort to classify them properly by subdivisions of expense instead of grouping them all under one general classification. By this method it is a comparatively simple matter to segregate the manufacturing expense so that at the end of every month, quarter, or year, comparisons can be made to determine whether the machine expense or the material expense has increased in undue proportion to the shop output.

When applying material expense as a separate item in making up costs of manufacture, care should be used in establishing a basis of distribution. The practice of applying material expense to jobs, by using the cost of the raw material used on each job as a basis, is a mistake frequently made by manufacturers and cost accountants. Their method of establishing this basis is to take the total cost of the raw material used during a normal year and find what relation this cost bears to the material expense for the same period. With this relation established in the form of a percentage based on the raw material cost, they proceed to apply it to all shop jobs in order to determine the proper proportion of material expense chargeable thereto.

There is only one correct way of distributing material expense and that is on the basis of bulk. Practically all material expense is incurred in a ratio proportional to bulk. By using the term "bulk" it is to be understood that the term "weight" can be used as a substitute, because it is a more standard way of measuring material, and because the bulk of an article is rather difficult to determine accurately. That there is quite a distinction between using the cost of the material and the bulk (or weight) of the material as a basis for material expense distribution will be readily noted from the following analysis: —

It is a comparatively simple matter to handle and store $1,000 worth of platinum; it requires, however, a considerable amount of time and effort to handle $25 worth of brass castings. More space is required in the storeroom for wrought iron pipe than is required for copper wire of equal value. Diamonds or precious stones require practically no handling expense as compared to the

cost of handling lumber. Freight elevators are necessary because of the bulk, or weight, of a bale of cotton, but an equal value in gold could be carried in a man's pocket without effort. The conclusion to be drawn, therefore, is that material expense does not, to any appreciable extent, vary in proportion to the cost of the material except as such increase or decrease in cost is due to a greater or less bulk of material used. There are instances where the consumption of materials of different kinds is so uniform year in and year out as to permit the use of the material cost figures as a basis for material expense distribution. Such cases do not warrant the segregation of material expense as a separate and distinct item of manufacturing expense, but in the average factory such a segregation is conducive to more accurate cost figures.

The possibility of error is so great where the cost of the raw material is used for material expense distribution as to warrant an illustration of how such an error can occur: Let us take, for instance, a factory whose manufacturing expense has been divided into machine expense and material expense. The material expense has been found by analysis to average 15 per cent of the cost of the raw material used as figured on the basis of a normal year. By analysis of past figures it has also been found that the machine expense of a certain department is 50 per cent of the labor. A job is assigned to this department and on its completion the cost clerk's figures would appear as follows:—

Productive Labor	$3.00
Machine Expense, at 50 per cent	1.50
Raw Material	6.00
Material Expense, at 15 per cent	0.90
Total Cost	$11.40

An inspection of the order shows that the high material cost was due to the fact that platinum was used in the manufacture of what happened to be an electrical instrument requiring platinum contact points, etc. If the material used had been zinc or copper the material cost would have been considerably less than ninety cents; yet by a study of the items which go to

make up material expense we found that it cost a great deal less to handle platinum than it did to handle copper, weight by weight; therefore, something must be wrong with this method of applying material expense to shop orders.

A study of the weight of the raw material, as found in the books of the company for the period over which the normal material expense was figured, showed that if reduced to a cost per pound basis the material expense would be five cents a pound; the charge of ninety cents should, therefore, have represented material weighing eighteen pounds. The platinum used amounted to only a fraction of an ounce; hence, the charge of ninety cents for material expense is actually over eighty-five cents too high, making a corresponding error in the shop cost as compiled by the clerk.

The foregoing example demonstrates very clearly that the cost of raw material cannot be used as a correct basis for distributing the material expense portion of manufacturing expense. It does not necessarily follow, however, that it is always advisable to figure this expense by a system requiring the weighing of the material on each order. Circumstances alter cases and it naturally follows that in such instances where the extra expense incurred in securing this data amounts to more than is justifiable in proportion thereto, a more general scheme of distributing material expense can be used.

A factory turning out a line of injectors, lubricators, valves, and grease cups, with an output varying but little from year to year, would be justified in establishing a basis of material expense distribution by classes of merchandise manufactured. Let us assume the normal material expense to be $3,000 a year with the output as follows: —

Injectors	6,000	pounds	=	10 per cent of total output.
Lubricators	24,000	"	=	40 " " " "
Valves	18,000	"	=	30 " " " "
Grease Cups	12,000	"	=	20 " " " "
Total	60,000	pounds	=	100 per cent of total output.

The material expense on an output of 60,000 pounds would amount to five cents a pound. Distributing this expense among

the four classes of merchandise on the basis of the output in pounds for each class, the charges would appear as follows: —

	Pounds Output		Material Expense
Injectors	6,000	at 5 cents per pound equals	$300
Lubricators	24,000	" 5 " " " "	1,200
Valves	18,000	" 5 " " " "	900
Grease Cups	12,000	" 5 " " " "	600
Total	60,000	at 5 cents per pound equals	$3,000

Reference to the cost ledgers at this point shows that the actual cost of the raw material used amounted to $9,000, divided among the four classes of merchandise as follows: —

Injectors	$1,200
Lubricators	3,900
Valves	2,700
Grease Cups	1,200
Total	$9,000

In order to establish a basis for the application of material expense as a percentage of the cost of the raw material used on each class of merchandise, it is only necessary now to reduce this material expense charge against each class to a percentage of the raw material cost. Working this out, the figures appear as follows: —

Class of Merchandise	Cost of Raw Material Used	Material Expense	Percentage Applied on Bases of Raw Material Cost
Injectors	$1,200	$300	25 per cent
Lubricators	3,900	1,200	31 " "
Valves	2,700	900	50 " "
Grease Cups	1,200	600	50 " "
Total	$9,000	$3,000	33 per cent

A percentage has now been established for the application of material expense to each class of merchandise. By simply computing this expense directly from the cost of the raw material used on each order the proportionate charge for this expense can be reached with reasonable accuracy.

XIII. Collecting Data to Compute Costs [1]

By Guido Sacerdote

The installation of a cost system in factories producing large varieties of goods, especially where the production is not confined to a standard and continuous production, but is mixed with special work, experimental work, new articles to be added from time to time to the regular line of manufacture and articles manufactured only intermittently as orders are received, is indeed a much more serious and complicated proposition than is the case in factories manufacturing only a few lines of standard goods.

In fact it is just this class of factories that need to collect the most minute and exact data on all the different operations that go to produce a certain article. It is in this class of factories that it is most desirable to install or extend the piecework system or premium system, or both. It is also often found that it is necessary to keep in force not one, but four different systems of pay at the same time, according to the nature of the work, and whether the rates for piecework or premium are already established, or will be established when sufficient data on a certain article have been collected.

The other two systems of pay usually found are the day rate, which is absolutely necessary for certain classes of work, like drawing, toolmaking, repairing machines, setting machines for work, etc., and the gang system, where a foreman has a contract at a certain piece-rate and either pays his own helpers or simply directs their work.

Sometimes a factory has been producing on either or all of these systems, and the aim is to simplify and reduce all rates to piece-rate or to premium plan wherever possible. Here again, all the data to be collected must refer to the smallest details of production, because goods manufactured in great variety are usually of moderate dimensions and made in large quantities.

It is the aim of this article to describe a system which was installed in a factory producing metal goods in large quantities

[1] *American Machinist*, November 9, 1911, pp. 870–874. Reprinted by permission of *American Machinist*. Forms are not reproduced.

and enormous variety, and having twelve different departments, each with a separate foreman. This is the plant of Figli di Raffaele Sacerdote, Turin, Italy.

It was run in the manner mentioned, with four different systems of pay; a system was in existence at the time giving fairly well the cost of the finished articles, but lacking in details regarding the different operations and charges. The aim in installing the new system was to obtain as complete data as possible regarding the individual operations, in order to correct and extend the piecework system combined with a premium plan; to divide the production by departments, in order to set a percentage on it; to interest directly each foreman in his department; to render possible the direct interchange of materials in course of manufacture between the different departments; to avoid unnecessary movement and work in the stockroom, and to obtain all the data relative to the movement of materials between the various departments and the stockroom.

In a system of this kind several things are especially important:

1. That the number of cards to be handled be reduced to a minimum, while the collection of details from them be as complete as possible.

2. That the system be simple and clear; that it require as little writing as possible, especially from the workmen themselves.

3. That it be uniform and elastic enough to adapt itself to be used in all classes of work and all through the factory.

4. That the old order of things be disturbed as little as possible, in order to avoid confusion and delays.

5. That the data obtained for each article and each operation be automatically filed to give an average cost on as large a production as possible.

6. That it give a means for comparing the efficiency of the different workmen and tools, and of separately computing piecework accounts and of comparing the results with day-rate costs.

7. That full data be obtained regarding the cost of production and maintenance of each tool, die, pattern, jig, etc.

8. That data be given for comparing the consumption of supplies, power, etc., on the part of different workmen for ultimately

setting a standard of consumption and a premium on savings effected.

In many factories the piece-rates, or the standard times for each operation, are set by a system of trials made by special men employed for this purpose, or by consultations between the superintendent, foremen and workmen. It is useless to recall the imperfections of these plans, which give in the most cases erroneous figures, unfair either for the workman or for the employer.

In a premium plan, founded on savings effected on a standard time for each operation, it is desirable that the standard time be proportioned to the hourly wages of each workman; in fact, inversely proportional to it so that a workman who has been given a certain wage rate must work by its relative standard time, so that he has a chance to earn his wages and a premium besides.

Owing to these considerations, the plan of establishing rates according to results of trials was discarded, and the one was adopted of collecting a great number of data extending over a long period for each operation, so that rates were based on actual work made in the factory under all possible conditions.

The system adopted had, therefore, to meet two prime conditions: (1) That it be able to furnish all the data which have been mentioned in regard to labor, material, supplies, direct and indirect, power consumption, etc., in order to deduct from them the standard times and piece-rates, and the standards of consumption of supplies and power in each operation. (2) That it be fit for being kept continuously in use in connection with work where the different standards and rates have already been set and in connection with work where the collection of data is to be made, in order to establish the standards.

In fact, even the established rates need to be revised from time to time, owing to changes in equipment, materials or wages, and as new articles are constantly produced, it is evident that the collection of new data must constantly be maintained.

The data to be used for the future setting of the standards come from three different sources: one is the estimated time based on a graduation of difficulty, or in other words on the wages of the class of workman which is supposed to perform the opera-

tion; another is the data coming from the workmen's time cards; and the third is constituted by a number of observations of the work made personally from time to time by the superintendent, foremen or special employees.

It is my intention to limit myself to the description of the means used for collecting the various data, which are those that must be carefully devised to save a vast amount of clerical work. The ultimate setting of the different standards and rates, and the complete summaries of cost, as well as the different forms giving information as to indirect expenses of various kinds, and various card indexes to be used for inventory or correspondence purposes will, therefore, not be considered.

After exhaustive consideration, it was decided to adopt a scheme where all the work was planned ahead before it entered the production stage; not only the work of preparing the tools and studying the various questions arising with the production, but also all the time cards and summaries of cost of labor and material to be used in connection with the manufacture of each item of each order. All the writing that could be done on the cards previous to their distribution, and all the information possible relating to the work, were prepared in the factory office upon receipt of each order.

The first step was the classification of the goods produced, each class being assigned a set of consecutive numbers sufficient for present and future needs. With this arrangement, all the indexes and documents pertaining to articles of a kindred nature could be filed together. Its advantages were most marked for consulting records, for cataloguing purposes and for the arrangement of the sample room.

To give an idea of the scheme: To the class "Building Hardware" was assigned the series 1 to 500; "Electrical Supplies" 501 to 1000; "Car and Wagon Accessories" 1001 to 1500, etc. Each article was given an individual number and the different parts of an article were given the same number, followed by an individual letter. For instance, supposing the distinctive number of "15 Ampere Single Pole Switch" to be No. 609, the different parts were numbered as follows: —

15 Amp. Single Pole Switch Lever No. 609-a
" " " " Fulcrum Part No. 609-b
" " " " Contact No. 609-c
" " " " Handle No. 609-d

When a part entered in the assembling of different articles, it was considered as an article of manufacture by itself and given an individual number.

Different card indexes were prepared containing the names and numbers of the articles, alphabetically or numerically ordered according to convenience, and kept constantly in order. One index was for the use of the manager's office, one for the correspondents, one for the stockroom, and one for the factory office, which in the present instance was combined with the drawing room.

For the purposes of this article we are solely interested in the form adopted for the factory office index, Form 1.

The front of the card, besides giving the number and name of the article, gives all the information relative to the sample representing the article, if any, to the drawing, patterns, dies, tools and jigs to be used in its manufacture. The rest of the space is occupied by information relating to materials, scrap, composition of alloys, etc. This is information for the use of the superintendent to prepare the necessary tools and to make requisition of materials upon receipt of the order.

The back of the card has all the necessary information relating to the way in which the article is manufactured. The first two columns give the sequence in which the different operations take place; the next two columns give the department and the machine in which the respective operations are to be performed; the fifth and sixth columns relate to the kind and numbers of the special tools for each operation; the next two columns contain information relative to power, gas for soldering, heat for forging, etc., and their approximate costs. It is understood, however, that these data were limited only to such operations where these were applied and had a direct bearing on the cost of the operations.

The next four columns refer to time — estimated and set — piece-rate, and premium to foreman for each operation and for a given number of articles, which are left blank to be filled in for

each case. The last two columns provide space for the quality and for remarks. Part of this information was to be used only in the future, like those relating to standard times — estimated and set — premium to foreman and quality. These were consequently left blank for the present time.

Of this Form 1 two files were prepared, one in alphabetical and one in numerical order. These constituted the basis on which all the system was founded.

Upon receipt of an order it was subdivided into its different items. For those items which had been manufactured before and for which Form 1 was already to be found, the summaries of labor and material and all the time cards were prepared beforehand in the manner which we will describe later. For the items which were new, the first step was to prepare all the drawings of the special tools necessary for production, giving a number to the drawings, tools, patterns, etc., and to fill immediately all the cards of Form 1 relating to the article and each of its parts. All the information relating to materials, to the succession of operations, etc., in fact all the information which it was possible to foresee, was inserted on the cards, and these entered in the indexes. Then the work for these proceeded in the same manner as for the other items.

Let us now examine the disposition of the time cards and summaries of labor.

The time cards are called and referred to as "Elements," and were provided in different colors, one color for each department. These were designed with the aim of giving the workman all the possible information in regard to special tools and machines to be used, and to necessitate on the part of the workmen and foremen as little writing as possible; and to be so distinct, furthermore, as to avoid any possibility of mistakes.

By glancing at the front of the card, and in fact at all the forms, the special study is apparent which has been given to the division of space to collect all the useful information in a clear way and with the necessity of but little writing.

The front of the "Element," Form 2, is devoted to information relating to labor and power, while the back is devoted to movements of materials.

Each element refers only to one operation on the same article, belonging to the same order and performed by the same workman. The front contains at the top the numbers of the order and of the article, the number of the operation, the description of the article and of the operation performed. It can, therefore, be filed according to all these data and it is, in fact, filed under the order number before the work is started and during its progress; under the article number when it is necessary to compile the summaries of labor for the article; or otherwise, according to convenience in the course of filing the different card indexes composing the entire cost system.

This feature was found to be very valuable indeed, as the same card was used over and over until all the data had been reported in the proper place.

In the middle section, space is provided for marking the hours for one month. If the work should start on a day different from the first of the month, on the 11th for instance, a line is drawn between the 10th and the 11th; this meaning that the element runs from the 11th of one month to the 10th of the next month.

Then there is space for giving the time employed in setting machines, wages, piece-rates, and amount of work performed under that element.

Besides containing the data relative to the different tools to use, there is space to be filled with data as to power, gas, steam, etc., used, the amount to be computed, naturally, on the total of the hours employed. Finally it is stated on the card whether the work is performed at piece-rate, day-rate, or otherwise, whether the rate applies only to the operation to which the card refers, or whether it applies to the same in combination with some other operation, given on some other card, which can naturally be performed by the same workman, or by a helper of the same workman.

The back of the card contains data as to materials received and delivered by the workman on that particular job. The material may come from the stockroom or from a different department, and may be delivered in the same way. When the work is passed

from one department to another it is always preferable that the respective foremen be present.

The summary of direct labor, Form 3, is compiled from the cards, Form 2. The front is devoted to the cost of the several operations going to make a complete article for a single order. The back is devoted only to collecting information on a single operation of the article written on the front, for different orders but for the same workman.

The summary of material is on Form 5, and for convenience in writing has been made in the shape of a folder composed of two cards of the same size as the summary of labor; the two can, therefore, be filed together when convenient. In other respects the form has nothing to distinguish it particularly from other forms in common use, and contains the ordinary data required as to the movements of materials between the stock-room and the factory. Each summary is, however, limited to a certain article belonging to a certain order number.

Let us see now how the system works. Supposing an item of a certain order is an article composed of two parts, three cards of Form 1 will be found in the index of the factory office; one for the article complete — the operations for this will probably be assembling, packing, finishing, etc. — and one for each part. Full information is given in each as to the tools, operations, etc., as described. For the purposes of the system, each Form 1 requires a complete set of elements and summaries of labor and material.

For each Form 1, therefore, the clerk fills the front of one summary of labor with the numbers of the order and of the article, quantity ordered and description; then he fills the first and third columns with the numbers of the elements and the name of the corresponding operations; these he deduces from the back of Form 1. The back of the same summary he prepares with the name of one operation, inserting the number of the order in the first space of the first column. Then he prepares in the same manner on the back as many summaries of labor as there are operations in the article referred to and proceeds to prepare the different element cards.

These he fills out in the same manner, leaving the workman's name in blank, also the wages, and inserting the piece-rate if any.

The element cards will be of different colors according to the departments in which the different operations have to be performed; they will evidently be equal in number to the cards of summaries of labor. Furthermore, one summary of material will be prepared with the number of the order and number and name of the article.

All these cards are put in special drawers of "Orders waiting," ready for being distributed when the work is started. The summaries of material, however, are at the disposal of the stockroom, as soon as the requisition forms have been filled.

After the work is started, the element cards are gradually distributed to the different departments as the work progresses; from the design it can be seen that the same card will last for one month; all the workman or the foreman has to do is to insert the number of hours each day in the space provided for each date.

The element cards do not return to the factory office until they are finished; more are issued from time to time for special operations not anticipated, or for renewals. They are reported on the front of the summary cost card. All the element cards are, however, returned at the end of each month for registration of piece-rate accounts, to go back to the respective workmen as soon as this be completed. The workmen are in the meantime paid at the day-rate, while the premiums, piece-rate differences, etc., are paid at the end of each month.

When a completed element card is returned, the data contained on the front are reported in the summary of labor, and also on the back of the summary card devoted to that particular operation; and so on until all the cards have been returned on a certain job.

The back of the card is used especially for controlling the individual movements of material; all the movements from and to the stockroom are inserted in the summary of material at the moment they take place.

At the finishing stage of the job we have, therefore, as many summary cards for labor as there are operations. The time cards or elements, however, which we had to handle have been very

limited in number, on account of their lasting for such a long time. If weekly reports are issued, they can be compiled also from the element cards, returning them to the workmen at the beginning of the new week.

When a second order for the same article is received, the same summaries of labor are used — filling the front of the second summary, and filling the second line of each on the back for the respective order and operation.

When as many orders have been completed on a certain article as there are operations, the set of summaries of labor is complete. We have in this manner obtained in compact order and with little effort many summaries of the cost of the complete article on the front of the cards, and the cost of each operation for each workman so disposed as to give the average cost of that operation distributed over a large production and a considerable number of orders. Keeping these data separate for each workman gives, moreover, means for comparing relative capacities and efficiencies.

It is seen that at the end a very limited number of cards have to be filled and handled, each requiring a moderate amount of work in order to be filled. It can readily be seen how elastic such a system is where all the documents can be filed in different ways, according to convenience.

To give an idea of the simplicity of the system, when installed two girls were all that were needed to keep the system running. The factory employed about 160 hands, and manufactured not less than 3000 different articles in the first six months in which the system was working.

A few words about the manner in which the data relating to special tools, dies, patterns, etc., were collected may not be out of place.

Form 4 is intended to serve as an index card, as a permanent inventory, summary of labor and material for the construction of the tool, and summary of labor and material for its maintenance. The aim in view is, of course, to save as much clerical work as possible, and to handle as few cards as possible.

For each class of tools there was a different color of cards. The front was devoted to such information as more closely pertained

to each particular class of tools. On the front of the form used for dies, for example, is given all the information relating to the number of the tool, the operation performed, its location, etc., and the value placed on it in the different inventories.

The backs of the cards were alike for all classes of tools. The work in producing and repairing equipment was always done by day-rate; besides, the data as to material need not be so particular. The items were summarized on this card, and when the tool was completed a heavy line was drawn underneath the totals. The remainder of the card was then devoted to future expenses for maintenance, the costs relating to production being reported at the right on the top, and those relating to maintenance at the right on the bottom. The total production being known during a given period of time, the expenses for production and maintenance could be properly subdivided and charged in the right proportion when compiling the general summaries of cost.

XIV. Methods of Cost Finding in Cotton Mills [1]

By William G. Nichols

In a mill having a wide variety of product, the conditions are usually different from those obtaining in a small mill or one engaged in the manufacture of yarns or one or two classes of goods.

1. In the nature of the case, it is usually a large mill, having numerous mill buildings, and filled with machinery in all conditions of wear, and sometimes not the best adapted to work produced.

2. In a small mill one efficient clerk will keep a written or mental record of everything that goes on. He can check freight bills and invoices, make up payrolls, enter reports and make up tables of production, etc. In a large mill, the organization is, or should be, more complete, and the systems of reports arranged so that a close watch may be kept of the expenses, of the condition of work

[1] *Transactions of New England Cotton Manufacturers' Association*, No. 68, pp. 251–271. Reprinted by permission of National Association of Cotton Manufacturers. Illustrations of several forms are omitted.

in process, of production of machines, and of rate of progress of orders. Accounts in the offices and departments are kept by those who are expert in this work. A record is thus made of many facts and data, which are useful or necessary in the actual subdivision of expense. There is thus available a large amount of the information necessary to the minute division of outlay, and the skill and practical knowledge for its classification.

Most of the data necessary for such a system of cost-finding as the following are recorded as the work progresses, and used in making up payrolls, reports of production, etc.

By recording these facts in such a way that they are available for cost-finding, much of the apparent labor of such a method as this is eliminated. The items are on record, somewhere. They should be arranged so as to be utilized.

In discussing the matter of cost-dividing, one frequently hears it stated that expenses should be divided as if all a mill were run on one class of work. This is right as a principle, but when we attempt to apply it we find practical obstacles. Suppose an establishment, one part of which is used for the production of fine goods and another for cloths of a much coarser grade. If all the mill were turned to the making of the coarser goods, there would be a relative loss in the quality and quantity of production, and a more than corresponding increase of cost. There must therefore be devised some way to carry out the theory underlying the principle. Let us change the statement to the following: Expenses should be divided in the proportion which they are incurred by the machinery engaged in making each class of goods. If this be correct, we have then reduced the problem of the division to the analysis of the expenses of manufacture, and the method of computing the same. And the more easily and simply this work can be well done, the more promptly will results be secured after the books are closed.

If one undertakes to obtain accurate results, however, a considerable amount of detail and clerical labor is indispensable.

The present paper is a sketch of method for the determination, as far as may be practicable, of the costs of manufacture in an establishment making fine and coarse organizations, both white

and colored, selling a part of its product as yarn, buying other kinds of yarn, and using various kinds of stock for different qualities of goods.

It will seem to some that these conditions are extreme and beyond likelihood to any actual occurrence. But while extremes are purposely selected, they are not more varied than existing conditions in more than one plant in New England.

We may suppose that a certain plant has been in operation for six months, and has produced the goods scheduled below. Let us first glance at the physical condition of the mill. It is in part old, part new. The older portion of the earlier style of mill architect is driven by water power. The later mill is driven by steam, is of modern construction, so far as the circumstances will allow, and fitted with machinery in good condition. There is a finishing department for the colored goods, while white goods are disposed of in the grey, warehouses for the storage of cotton and goods, and tenements for the operatives.

When the accounts are made up, it is found that goods have been produced to the following amounts and with the accompanying particulars. — Table A.

[This table, which is not reproduced, shows vertically the kind of goods. For each kind of goods entries are made in the following columns: — (1) width; (2) pounds produced, six months; (3) number of yarn, warp and filling; (4) per cent of warp, and of filling; (5) pounds of warp or filling, six months, weekly; (6) number of looms; (7) pounds per week per loom; (8) total pounds from looms. This is followed by statistics for production by sizes of yarn on spinning frames, and on mules, and for quantity combed. At the bottom of the table each column is totaled.]

The first four columns give necessary data of the organization. Column 4 states the percentage of the cloth which is warp, and that which is filling. In computing this the number of the yarn should be taken from the average weighings of the six months, and not as the nominal number given in column 3.

If the weight of the cloth from the loom given in column 2 be multiplied by the percentage of warp or filling in the cloth, it will give the pounds of yarn which are necessarily used in its

production. These are extended into columns 7, 8, etc., and as the same kind of yarn frequently has several uses, the footings of these columns give the total amount necessary.

Having obtained this schedule of the output of the mill, we next take up the statement of expenses and income.

An examination of manufacturing costs will disclose that they may be divided into three classes:—

1. Material or stock. That is cotton of various grades, waste or yarn used.

2. Labor of manufacturing.

3. Those miscellaneous and general expenses such as repairs, supplies, sizing materials, power, insurance, taxes, depreciation and administration.

Taking these in the order mentioned we have first to deal with:—

The Cost of Stock

It is impossible to make accurate estimates without knowledge of the quantities of stock used and goods produced. In this method the woven goods are all weighed in the grey immediately after weaving, and yarns sold are of course weighed for sale. A table showing the pounds of yarn sold, or necessary for making each kind of goods, as shown in Table A, but classified according to the grade of stock represented, is first prepared as given in Table B on the next page.

It will be noticed that there are five kinds of stock used:—

Gulf cotton for warp, at an average cost of	7	cents.
Upland cotton, for filling, at an average cost of	6.80	"
Egyptian cotton carded, at an average cost of	14	"
Egyptian cotton combed, at an average cost of	14	"
Waste, at an average cost of	4	"
Yarn purchased, at an average cost of	80	"

As is frequently the case, something in the way of economy in stock is sacrificed for the purpose of using as few grades as possible, avoiding constant change, and risk of running short of some grade.

It is not sufficient to take for granted that so many pounds of stock required have made the pounds of yarn required and used

TABLE B. TABLE OF STOCK USED

	Gulf Cotton G		Upland Cotton U		Egyptian Carded E		Egyptian Combed E. C.		Waste W		Yarn Purchased Y	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Cotton opened	1,660,930	......	917,576	......	81,899	......	212,214	......	188,524	$10,251.44	......	......
Waste used	......	......	......	......	......	......	......	......	208,000	8,112.00	......	......
Yarn purchased	......	......	......	......	......	......	......	......	......	......	5,919	......
Total	1,660,930	$116,265.10	1,071,476	$72,860.37	81,899	$11,465.86	212,214	$29,709.96	396,524	18,363.44	5,919	$4,735.20
Waste made (deducted)	248,760	4,883.13	171,000	2,768.70	11,100	230.66	54,630	1,561.05	40,000	406.00	46	1.20
	1,412,170	111,381.97	900,476	70,091.67	70,799	11,235.20	157,584	28,148.91	356,524	17,957.44	5,873	4,734.00
Increased stock in process (deduct)	30,000	2,415.00	......	......	......	......	5,000	740.00	1,000	51.00	673	528.40
Decreased stock in process (add)	......	......	5,000	391.00	987	158.90	......	......	......	......	......	......
Total	1,382,170	108,966.97	905,476	70,482.67	71,786	11,394.10	152,584	27,408.91	355,524	17,906.44	5,200	4,195.60

NOTE. — In this table the waste made includes all loss between cotton or other stock used and the pounds of yarn or goods produced.

in weaving or otherwise. In mills making a large variety, the stock on hand changes so much as regards quantity and quality that this fact must be taken into account. For instance, in taking this account of stock in process, at the close of the six months it was found that there were 5,200 pounds of No. 50 combed yarn on hand over the last inventory. Briefly stated the process of finding the cost of materials is as follows: —

Obtain the total amount and cost of each grade of stock put in process.

Deduct from this, at the present value, the amount in pounds and dollars, which this inventory shows over the one last preceding, or *vice versa.*

Deduct in each grade of stock the value of waste made. If the waste from one class of stock has been used for another, it should be credited to the grade where made, and charged to the other grade, where it is consumed.

Divide the cost of each grade, as now obtained, by the pounds of yarn made. If more than one grade enters into a fabric, the proportionate part of each is taken at its own price.

In obtaining the value of stock on hand a table is convenient, and it is also useful in affording details required in finding the labor cost.

The Cost of Manufacturing Labor

By the term "Manufacturing Labor," it is meant to define only that labor bestowed upon direct manufacturing operations, such as carding, dyeing, and weaving, and not the labor expense of repairs, power, and other departments equally necessary but not handling the stock in process of conversion into yarns or fabrics.

As in determining the cost of material, the first operation is the preparation of a statement of product; the same plan is followed in determining the labor cost; and a table should be prepared summarizing all these labor costs that none may be omitted in the distribution.

The labor cost in some departments of a mill can be separated, each to its own mark of goods, much more easily and accurately

than in others. As a rule this is the case the further toward completion the goods have passed.

For instance, on the cards material may go through in the same manner, to be used for fine or coarse work, as it passes to the roving frames, part of the same hank roving may be used on spinning frames, and part put behind a finer roving frame for another operation. The yarn made in the former case may be used in a dozen grades of goods, which may each receive separate treatment in weaving, and further divided by particular treatment in finishing.

The methods of getting at the cost will therefore vary in different departments. In general they may be defined as a division and classification of the payrolls, at the time the labor is performed and the payroll made up, and a summary of the results at the end of the half year.

In the card room this is effected by the notation on the payroll, in a column provided for the purpose, of the occupation of each employee, and if more than one kind of work passes through the room, the kind each employee is engaged on. When the work has reached the slubber and roving frames, a record is kept of the hanks or pounds produced at each hank roving, whether fine or coarse, and the wages paid for producing it. If any frame is changed from fine roving to another, a corresponding note is made of the time it was done, and the length of run on each hank.

These amounts are posted from each payroll to a sort of ledger that they may be added at the end of the six months. At that time, also, the wages of employees on pickers, cards, and drawing frames are added.

If we now wish, under circumstances existing in this mill, to ascertain the card-room cost of making the warp yarn in the print cloth, we proceed as follows, taking the data from Table A. Yarn 28, from 4.2 hank roving, made on fly frames supplied by 1.5 hank roving made from .6 hank slubber roving. We find the total amount of yarn made from .6 slubber roving, which was consumed in making the woven product and yarn sold, to be 1,700,254 pounds. Next find how the stock in process at the end of the half year compares with the stock at the begin-

ning from tables previously referred to. It will be necessary to compare the weights of .6 hank roving and the aggregates of all rovings and yarns in all operations previous to woven cloth where said yarns are made from .6 hank. We may suppose this is found to be 35,000 pounds more at the end of the six months than at the beginning, which should be added to 1,700,254 as these 35,000 pounds of roving have been made above what was used in cloth produced, etc.

The cost of this card room thus far is summarized from the payrolls, as follows: —

Oversight,	General, scrub, elevator,
Section hands, grinders, strippers,	Slubber tenders,
Railway and drawing tenders,	Doffers.

Total cost divided by 1,735,254 equals cost per pound of carding .6 hank roving.

Next find the additional charge for running this through the intermediate frame, making 1.5 hank roving. From the records we may find that 509,436 pounds of 1.5 hank roving was required for goods produced, and from tables not shown, that the excess of stock at the close of the six months was 10,000 pounds. Total 519,436.

The payrolls show the following costs: —

Section hand,
Intermediate tenders,
Oilers.

Here we first encounter the problem of dividing the expense of overseeing and those general duties which have no direct relation to any particular class or grade of stock or machinery, but have usually to do with the care of the rooms, such as sweepers, elevator hands, water carriers, and that third genus of employees, such as roving carriers, oilers, doffers, band boys, etc., who have to do with machinery running, perhaps, on a dozen different kinds of work, and in a way that makes it impossible to do better than to estimate the equitable division of the expense.

There are one or two principles which may guide us in making these divisions: —

1. That those who work about the room and in the keeping of machinery in condition for service, as section hands, oilers, and scrub women, are independent of the product of the machinery and their wages should be divided according to the machines or spindles treated.

2. The case of doffers, roving carriers, filling carriers, etc., is a different one; their number is proportioned more nearly by the amount of work produced by the machinery, and not by the number of machines themselves.

A roving frame on 20 hank will need as much oiling as one on 2 hank, but it will have no use for doffers. The best rule for the division of such labor, therefore, is in the ratio of production in pounds.

3. Overseers, second hands and bookkeepers in large rooms have to do with the quality and quantity of production, but more directly with people than machines. And while it is true that one alley boy may need more watching than the best slubber tender, all things considered, it is perhaps as fair a rule as any to divide such expense last of all and apportion it as all other labor divides itself.

After the same manner we find the amount of 4.2 hank roving to have been 509,436 plus 10,500 pounds equals 519,936 pounds.

And the cost of running over fly frames

Section hand,
Fly frame tenders,
Doffers,
Roving hands,
Sweepers.

Total cost on fly frames divided by 519,936 pounds equals cost per pound.

We may thus tabulate the labor cost of making 4.2 hank roving:—

Carding,	cents	per	pound.
Slubbers,	"	"	"
Intermediates,	"	"	"
Fly frames,	"	"	"

But there are 35,000 pounds of stock on hand in process, above the stock six months ago, which has passed through the operation

of carding in this room. It has been stated, previously, that this along with other kinds has already been placed to the credit of the stock used, and it is carrying out the same practice that these 35,000 pounds are made a part of the divisor for finding the cost per pound.

In fact, the increase of stock in process is credited to cotton account, before the books of the corporation are closed, and the labor expended on this 35,000 pounds together with other similar labor is credited to the account of manufacturing labor as being a valid part of the inventory. In the same way dyestuffs expended on stock in process are placed to the credit of dyestuffs account.

TABLE E

CARD ROOM STATEMENT, SIX MONTHS ENDING......................

Operation	Size Hank Roving	Pounds Made	Payroll	Remarks	Labor Account	
Picking.............	..	2,880,000	$2,877.94	....	Cr.	$7.26
Carding No. 1.......	..	1,800,000	5,506.18	....	Cr.	45.37
Slubbing No. 1......	.6	1,735,254	1,785.24	....	Cr.	35.00
Intermediates.......	1.2	935,000	936.00	760 spindles } 1280	Cr.	14.72
"	1.5	540,876	660.66	520 "	Cr.	11.00
Fly frames..........	3.	930,000	2,040.61	spindles } 3840	Cr.	44.00
" "	4 2	550,376	1,293.59	"	Cr.	26.25
Jack "	9.	151,000	907.28	....	Cr.	30.00
Carding No. 2.......	..	1,035,000	2,810.26	Average Cards 50 } 70	Dr.	25.87
" for combing .	..	157,784	1,262.27	" " 20	Cr.	41.60
Combing No. 2......	..	157,000	1,184.00	....	Cr.	39.00
Slubbers No. 2.......	..	1,040,000	1,305.00	....	Dr.	12.00
Intermediates No. 2..	..	1,045,000	1,960.00	....	Dr.	9.00
Fly frames No. 2.....	..	770,000	1,930.09	....	Cr.	9.60
Jack " " "....	..	77,000	626.29	....	Cr.	...
			$27,085.41			

Table E shows the summary of the card room payrolls for the half year. This shows the total cost of the various operations in this department, arranged so that we may separate the cost of each step in the progress of the work. It is supposed that there are two card rooms, but only one picker room, and that in each card room an account is kept of the spindles on each size of roving. It also shows the amount paid in the card room for labor on the stock in process over and above what was in process six

months ago. The amount in itself is not of much importance in the card room, but in following this system it is of great importance in subsequent operations, as the amount of some particular class of work may greatly change, although the average value of stock in process may not be much affected.

The expense of each operation should receive credit for all work done on stock on hand in excess of six months previous and an extra charge should be made for labor if the stock in process has decreased. Tables similar to this are made up for each department of the mill.

In the spinning and spooling room we will meet almost the identical conditions as among the roving frames, and may determine the cost after the same methods.

In the warp room we are able to go one step further toward accurate division, in that we may commonly assign directly to each mark of goods the cost of the machine tender's wages.

Each warp tender is provided on Monday with the following ticket, and it is understood that her wages are made up from it, so that there is small chance for any omission, and any work done by the day must also appear on the ticket in order to receive credit on the time book.

WARPING ROOM ....(Employee's name).... Week ending ....

Mark	Pattern	No. Yarn	Ends	Yards or Warps	Pounds	Time	Rate	Amt.	Check		

These tickets are returned to the office with the payroll, and the charges for warping each mark of goods are posted into a book kept for the purpose.

The wages of other hands are separated into various classes as

Tying hands,
Section and beam truckers.

The wages of tying hands are divided according to the pounds of each kind of yarn done, on the principle that it costs the same to tie a full spool of, say, a pound weight, whether filled with 20 or 50 yarn.

The wages of other helpers, as truck hands and section hands, are divided according to the proportion of wages of warpers.

The labor of beaming and chain quilling for colored work is treated in the same way, on blanks ruled in almost the same form. In dressing and web drawing the same principle is applied in blanks ruled as follows:—

DRESSING ROOM.....(Employee's name)..... Week ending.................................

Mark	No. Yarn	Ends	Yards	Pounds	Hours		Amt.	Check	

TWISTING / WEB DRAWING } .....(Employee's name)..... Week ending.................................

Mark	Pat-tern	Ends	Cuts	H'rness	BEAMS						Hours	Rate	Amt.	Check
					M.	T.	W.	T.	F.	S.				

The remaining payroll is classified and then divided as follows:

Overseeing,	Divide same ratio as total slashers and web drawers.
Slasher helpers,	" " " " " " " " "
Sweeper and scrub,	" " " " " " " " "
Truckmen, Sizemaker, Snarler,	" " " " pounds done.

The cost of weaving is always one of the easiest to determine. Looms are limited in their adaptability to different sorts of goods, and though one weaver may tend looms holding warps of various marks there is usually a different price per cut for each. The number of cuts of each kind of cloth multiplied by the price per cut, with the addition of any day work in weaving, gives the total cost. To this must be added the expense of

Section hands,	divided in proportion of looms operated.
Filling carriers,	" " " " pounds produced.
Inspecting,	" " " " yards produced.
Room girls, Sweepers, etc., Overseeing,	" " " " total or other weaving costs.

Of course any of these expenses may be assigned to any mark of goods, if by reason of peculiar circumstances it can be definitely placed, but the above seems the most reasonable rule, ordinarily.

The division of the labor of finishing is very difficult, as many of the employees in this department spend their time handling a variety of goods, or working by turns at different tasks. There are, also, many minor operations involving slight expense, so that the labor necessary to subdivide the labor seems trivial.

In the mill which we are studying the finishing department has the conduct of the following operations: —

Trimming, brushing and measuring, divided per yards passed.
Sewing, divided per pieces woven and sewn.
Tentering, divided per yards goods receiving hard finish.
Calendering, divided per yards goods receiving hard finish.
Folding, divided per yards goods passed.
Inspecting, divided per yards goods passed.
Winding, divided per yard goods passed.
Backing, divided per pieces woven.
Pressing, divided per pieces pressed.
Banding, divided per pieces banded.
Napping, divided $\left(\frac{\text{Yards napped} \times \text{runs}}{\text{Widths run at one time.}}\right)$
Binding, divided per blankets bound.
Packing, divided per cases packed.
Sample card making, charged to kind of cards made.

In the dye house a special report is prepared by the overseer, stating how much labor has been bestowed upon each kind of work. This report is appended to the payroll and is necessary

because the small amount of work and its irregularity render it inexpedient to keep the same men upon one job.

Some mills even carry the division so far as to specify the color engaged on when dyeing, and are thus enabled to know the labor cost of each shade.

Having disposed of the cost of stock and labor of manufacture, there remains the third division of outlay, commonly known as

The General Expense

Out of the list of accounts usually kept, we may select three or four which may be analyzed by reference to the books, or which may be divided on a reasonable basis.

Sizing Materials may be divided according to the pounds of warp dressed (which would exclude ply yarns).

Dyestuffs may be divided according to the pounds colored, or a schedule may be made up of the cost of each color, and used as a guide to divide the cost of material.

Finishing and Packing Materials are best disposed of by examining the charges to the account, and laying upon each kind of goods the cost of the cases, bands, cards, tape, burlaps, rope, paper, etc., by the best knowledge available of the amount used.

Freight on Goods should be separated, and the amount prepaid and freight allowances charged to the class of goods for which incurred. The same is true of storage charges.

The most important of the general expenses are thus left untouched. They usually comprise the following expenses, which are kept separate to varying degrees of detail in different offices: —

Fuel for steam, for power, heat, dyeing, and drying on dry cans, slashers, and finishing machinery,

Water power,	Taxes,
Oil,	Insurance,
Supplies,	Repairs on machinery,
Belting,	Repairs on mill building,
Moistening apparatus,	Furniture and tools,
Watchmen,	Machinery,
Stable and yard work,	Depreciation,
Lighting by gas or electricity,	Interest,
Salaries and office expenses,	Expenses unclassified.

In making up Table H [omitted in reproduction], a list of the machines in operation is first made. Idle machinery is not included. The machinery is listed at its first cost, including shafting. The amounts in this part of the table are used to determine the proportion of the cost of maintenance to be charged to each department. As this is charged by proportion it is immaterial whether we take the machinery at half its value, consider it on the average half worn out, or take it at its full first cost. The latter plan is followed because simpler.

This equalizes the cost of insurance, taxes, and watch, so that they are not thrown with undue weight upon new machinery. It also enables us to distribute the loss through depreciation. In most mills this is met by charging to running expenses a partial or full amount of the cost of new machinery, and not by a systematic reduction of the machinery on the inventory. The former method is more elastic and convenient, as affording an opportunity to carry forward or to reduce the new machinery account, according as the season has been more prosperous or less; but a systematic charging off, say of 5 per cent of the first cost of each machine, every year, if followed by some managers, in the past, might have given a warning of the condition which remained until a period of depression revealed it, by a failure to meet adverse circumstances.

In the columns under buildings and furnishings, we enter the floor space occupied by such class of machines, taking it in such a manner as to cover all the space in each room. [Cost per square foot is shown for elements of equipment.] Separate columns are also provided for piping, heating, wiring for lights, moistening apparatus whenever it is installed, automatic sprinklers, and the cost of building construction.

In this table provision is also made for a statement of the power used in each department. It is not necessary for this to be the exact amount of power consumed, in order that the account of it may come out even, for the cost of power is divided on a percentage basis.

In the remaining columns the percentage basis is abandoned, and actual expense records take its place. We suppose that a

record is kept of all the labor and iron, or other material, used in repairs in each department. The balance remaining, after deducting their sum from the total amount charged to this account, including the estimated cost of power, oil, supplies, maintenance, supervision, etc., is added, for convenience, as a percentage of the ascertained cost in a third column.

The same plan is followed in the distribution of the cost of supplies, oil, belting, light, roll covering, and moistening. Only one column is used for each of these.

The foregoing table or list exhibits the details for arranging the distribution of expense. The summaries of the departments are now transferred to another condensed table, Table K [omitted in reproduction].

It will be noticed that the expenses which we have been considering pertain to one or two sorts, or both. (1) Those which relate to the care of the property and to keeping it in condition, by the repair of loss through wear and decay. (2) The expense of motive power, made up of fuel, engine repairs, interest on water-power and steam plant, labor of engineers, firemen, etc. There is something to be said for including the expense of oil and belting with power, but for convenience they are here included with maintenance.

Table H is only a partial list of machinery, but Table K is a complete summary of all departments. In the second column is placed the value of machinery in each department, including that of power and repair plants, etc. In the third column opposite this value is entered the per cent which it bears to the total value of machinery as found in the footing of the second column. The amount paid for insurance, taxes, watch, and depreciation or renewal, which is shown in the box at the head of the columns, is then divided among the departments, in the proportion of the value of machinery exhibited in the percentages set down in the third column. The net amount thus chargeable to each department is entered in column 4. The amount set against power plant is then entered in the box at the head of the power column as a part of the cost power. The same with repairs, moistening, etc., which are entered on Table H.

The expense of maintenance of buildings is computed after the same plan as machinery.

The expense of light, oil, repairs, supplies, roll covering, belting, and humidifying in each department is summarized from Table H and placed in column 8.

The expense of motive power is then divided after the same manner as maintenance, by the percentages in column 10.

The total expense of each manufacturing department for power and maintenance, including repairs, is then entered in column 12. The expense for repairs of power plant is not so treated, having been already provided for.

The departments of repair, power, light and moistening are mutually dependent on one another. There are charges of power to repairs, and repairs to power, and of both to moisteners. An estimate of these charges must, therefore, first be made, when the work may proceed as outlined above.

It will be noticed that card room machinery is twice listed in the Tables H and K, which is to represent the two different rooms in the plant under consideration.

Having obtained the total maintenance and power charges for each department, they may be transferred so far as they apply to sheets like Table M, which represent a form used for assembling the costs of manufacture. [On table, which is omitted, operations, such as Picking, Carding-Warp, Carding-Filling, are listed vertically. Columns are provided for:—LABOR, (1) Cost of all similar work, (2) Proportion on *Flannel Check*, (3) Cost on *Flannel Check;* MAINTENANCE AND POWER, (1) Cost of all similar work, (2) Proportion on *Flannel Check;* TOTAL AMOUNT; COST PER POUND OF CLOTH. To the total for these costs is added cost of Sizing Materials, Dyes, Finishing Materials, Freight on Goods, per cent for Administration expenses, per cent for Miscellaneous expenses, cost of cotton and yarn purchased, per cent for Interest, per cent for Profit. The final entries are Total Cost and Cost per Yard.] One of these blanks is used for each kind of goods on which it is wished to obtain the cost. And when the cost of all the varieties is found, the sum of all should equal the total expense for the period. This sheet is for colored flannel check,

but there are spaces for expenses not incurred in flannel check, but necessary in the use of the same forms in other goods.

Besides the sources of outlay which we have already considered, there remain administration expenses which include all office expenses, salaries of general executive officers, etc. There are always numerous expenses which are difficult to classify, because they apply to no particular department, or are so small in amount as not to call for a separate account. For instance, teaming and yard work, after having been charged to departments as far as practicable, leaves a balance which it is impossible to classify.

These may now be added to the cost of labor and maintenance in the same percentage as the sum of all such expenses bears to all labor and maintenance, etc. So far as we may discover any principle applying to the division of these expenses, they should be borne by each mark of goods, in inverse proportion to the rate of production. If one grade of goods can be woven, or one number of yarn spun much more rapidly than another, it should bear a proportionately lesser rate of the general expenses per pound.

In a mill producing goods under such diverse conditions, it is impossible to take either the loom or the spindle as the basis of production, as some cloths are made of purchased yarn and other very different yarns are sold and not woven. But this exact result is yet more equitably accomplished in the manner stated, for not only is the production of the loom a factor, but the production of the spindles also.

It will be noticed that these expenses are added before the inclusion of the cost of material. The cost of stock is next entered in the spaces provided, and we have obtained the total manufacturing cost.

It is sometimes the case that in one class of goods there will be various styles or patterns differing in organization.

For instance: there might be a line of blankets made of the same yarns, woven on the same looms and yet of various picks, widths, lengths, and weights. Or there might be goods having gauze leno and corded effects with different figures and ply yarns.

These may be classed together as one grade of goods in some of the stages of cost finding but a separate account may be kept of the operations of warping, weaving or whatever else desired.

There yet remain interest, profit and commissions.[1] The first is added as a percentage of the manufacturing cost.

It is of course understood that profit is a matter governed entirely by circumstances, and one which cannot be regulated at will nor by any arbitrary rule. Nevertheless, so long as business is carried on for profit and not for pleasure, so long dividend accounts may be legitimately included as a portion of the cost of manufacture. Attention is called to the fact that the percentage to be added for a reasonable dividend should be based not on the full cost of the goods, but on the cost of labor and maintenance. A percentage of the selling price, which might seem reasonable, might also be higher or lower than necessary for fair profit, according to the production possible on that same kind of goods. Of two marks of goods which have the same cost to the mill, a profit of 5 per cent of the selling price on one might yield as much as 10 per cent on the other, if the character were such that the same machinery could produce double the amount. The fact is more fully illustrated where the two objects of manufacture are entirely dissimilar. It was stated some years ago, by the Commissioner of Labor of Massachusetts, that a profit of 4½ per cent on the selling price of boots or shoes would be equivalent to 14 per cent on the capital invested, while gas and residual products show a profit of 21 per cent of the selling price, but less than 8 per cent on capital invested.

The last item to be added is the commission for selling goods.

In reviewing this method, the first impression will doubtless be that it entails a great amount of labor, but this is always the case where so much detail is necessary, and there seems to be reason for the belief that the labor, after this plan, is no greater than in others giving equally certain results. In fact a large portion of the work may be done before the accounts are closed.

[1] With this statement regarding interest, profit and dividends I cannot agree. Interest is an expense to be included but profit is not expense. [Editor.]

As remarked in the beginning, the data used in this method of finding costs are largely required for other purposes, and if care be taken to formulate them aright, they may be found ready at hand. Carefully followed out and intelligently used this method will give the most accurate results. By this method the labor is thrown more upon the head office and less upon departments. It is therefore well suited to those mills which employ a cost clerk for the purpose of making estimates of past and prospective products.

XV. The Relation between Production and Costs[1]

By H. L. Gantt

Manufacturers in general recognize the vital importance of a knowledge of the cost of their product, yet but few of them have a cost system on which they are willing to rely under all conditions.

While it is possible to acquire quite accurately the amount of material and labor used directly in the production of an article, and several systems have been devised which accomplish this result, there does not yet seem to have been devised any system of distributing that portion of the expense, known variously as indirect expense, burden or overhead, in such a manner as to make us have any real confidence that it has been done properly.

There are in common use several methods of distributing this expense. One is to distribute the total indirect expense, including interest, taxes, insurance, etc., according to the direct labor. Another is to distribute a portion of this expense according to direct labor, and a portion according to machine hours. Other methods distribute a certain amount of this expense on the material used, etc. Most of these methods contemplate the distribution of all of the indirect expense of the manufacturing plant, however much it may be, on the output produced, no matter how small it is.

If the factory is running at its full, or normal, capacity, this item of indirect expense per unit of product is usually small. If

[1] *Journal of the American Society of Mechanical Engineers*, vol. 37, pp. 466–468. Reprinted by permission of American Society of Mechanical Engineers.

the factory is running at only a fraction of its capacity, say one-half, and turning out only one-half of its normal product, there is but little change in the total amount of this indirect expense, all of which must now be distributed over half as much product as previously, each unit of product thereby being obliged to bear approximately twice as much expense as previously.

When times are good, and there is plenty of business, this method of accounting indicates that our costs are low; but when times become bad and business is slack, it indicates high costs due to the increased proportion of burden each unit has to bear. During good times, when there is a demand for all the products we can make, it is usually sold at a high price and the element of cost is not such an important factor. When business is dull, however, we cannot get such a high price for our product, and the question of how low a price we can afford to sell the product at is of vital importance. Our cost systems, as generally operated at present, show under such conditions that our costs are high and, if business is very bad, they usually show us a cost far greater than the amount we can get for the goods. In other words, our present systems of cost accounting go to pieces when they are most needed. This being the case, many of us have felt for a long time that there was something radically wrong with the present theories on the subject.

As an illustration, I may cite a case which recently came to my attention. A man found that his cost on a certain article was thirty cents. When he found that he could buy it for twenty-six cents, he gave orders to stop manufacturing and to buy it, saying he did not understand how his competitor could sell at that price. He seemed to realize that there was a flaw somewhere, but he could not locate it. I then asked him what his expense consisted of. His reply was labor ten cents, material eight cents, and overhead twelve cents. My next question was: Are you running your factory at full capacity? I got the reply that he was running it at less than half its capacity, possibly at one-third. The next question was: What would be the overhead on this article if your factory were running full? The reply was that it would be about five cents; hence the cost would be only twenty-three cents.

The possibility that his competitor was running his factory full suggested itself at once as an explanation.

The next question that suggested itself was how the twelve cents overhead, which was charged to this article, would be paid if the article was bought. The obvious answer was that it would have to be distributed over the product still being made, and would thereby increase its cost. In such a case it would probably be found that some other article was costing more than it could be bought for; and, if the same policy were pursued, the second article should be bought, which would cause the remaining product to bear a still higher expense rate.

If this policy were carried to its logical conclusion, the manufacturer would be buying everything before long, and be obliged to give up manufacturing entirely.

The illustration which I have cited is not an isolated case, but is representative of the problems before a large class of manufacturers, who believe that all of the expense, however large, must be carried by the output produced, however small.

This theory of expense distribution is quite widespread, and clearly indicates a policy, which in dull times would, if followed logically, put many of our manufacturers out of business. In 1897 the plant of which I was superintendent was put out of business by just this kind of logic. It never started up again.

Fortunately for the country, American people as a whole will finally discard theories which conflict with common sense; and, when their cost figures indicate an absurd conclusion, most of them will repudiate the figures. A cost system, however, which fails us when we need it most, is of but little value and it is imperative for us to devise a theory of costs that will not fail us.

Most of the cost systems in use, and the theories on which they are based, have been devised by accountants for the benefit of financiers, whose aim has been to criticize the factory and to make it responsible for all the shortcomings of the business. In this they have succeeded admirably, largely because the methods used are not so devised as to enable the superintendent to present his side of the case.

Our theory of cost keeping is that one of its prime functions is to enable the superintendent to know whether or not he is doing the work he is responsible for as economically as possible, which function is ignored in the majority of the cost systems now in general use. Many accountants, who make an attempt to show it, are so long in getting their figures in shape that they are practically worthless for the purpose intended, the possibility of using them having passed.

In order to get a correct view of the subject we must look at the matter from a different and broader standpoint. The following illustration seems to put the subject in its true light: —

Let us suppose that a manufacturer owns three identical plants, of an economical operating size, manufacturing the same article, — one located in Albany, one in Buffalo and one in Chicago, — and that they are all running at their normal capacity and managed equally well. The amount of indirect expense per unit of product would be substantially the same in each of these factories, as would be the total cost. Now suppose that business suddenly falls off to one-third of its previous amount and that the manufacturer shuts down the plants in Albany and Buffalo, and continues to run the one in Chicago exactly as it has been run before. The product from the Chicago plant would have the same cost that it previously had, but the expense of carrying two idle factories might be so great as to take all the profits out of the business; in other words, the profit made from the Chicago plant might be offset entirely by the loss made by the Albany and Buffalo plants.

If these plants, instead of being in different cities, were located in the same city, a similar condition might also exist in which the expense of the two idle plants would be such a drain on the business that they would offset the profit made in the going plant.

Instead of considering these three factories to be in different parts of one city, they might be considered as being within the same yard, which would not change the conditions. Finally, we might consider that the walls between these factories were taken down and that the three factories were turned into one plant, the

output of which had been reduced to one-third of its normal volume. Arguing as before, it would be proper to charge to this product only one-third of the indirect expense charged when the factory was running full.

If the above argument is correct, we may state the following general principle: the indirect expense chargeable to the output of a factory bears the same ratio to the indirect expense necessary to run the factory at normal capacity, as the output in question bears to the normal output of the factory.

This theory of expense distribution, which was forced upon us by the abrupt change in conditions brought on by the war, explains many things which were inexplicable under the older theory, and gives the manufacturer uniform costs as long as the methods of manufacture do not change.

Under this method of distributing expense there will be a certain amount of undistributed expense remaining whenever the factory runs below its normal capacity. A careful consideration of this item will show that it is not chargeable to the product made, but is a business expense incurred on account of our maintaining a certain portion of the factory idle, and chargeable to profit and loss. Many manufacturers have made money in a small plant, then built a large plant and lost money for years afterwards, without quite understanding how it happened. This method of figuring gives a clear explanation of that fact and warns us to do everything possible to increase the efficiency of the plant we have, rather than to increase its size.

This theory seems to give a satisfactory answer to all the questions of cost that I have been able to apply it to, and during the past few months I have laid it before a great many capable business men and accountants. Some admitted that this viewpoint would produce a very radical change in their business policy, and are already preparing to carry out the new policy.

It explains clearly why some of our large combinations of manufacturing plants have not been as successful as was anticipated, and why the small, but newer plant, is able to compete successfully and make money, while the combinations are only just holding their own.

The idea so prevalent a few years ago, that in the industrial world money is the most powerful factor, and that if we only had enough money nothing else would matter very much, is beginning to lose its force, for it is becoming clear that the size of a business is not so important as the policy by which it is directed. If we base our policy on the idea that the cost of an article can only legitimately include the expense necessarily incurred either directly or indirectly in producing it, we shall find that our costs are much lower than we thought, and that we can do many things which under the old method of figuring appeared suicidal.

The view of costs so largely held, namely, that the product of a factory, however small, must bear the total expense, however large, is responsible for much of the confusion about costs and hence leads to unsound business policies.

If we accept the view that the article produced shall bear only that portion of the indirect expense needed to produce it, our costs will not only become lower, but relatively far more constant, for the most variable factor in the cost of an article under the usual system of accounting has been the "overhead," which has varied almost inversely as the amount of the product. This item becomes substantially constant if the "overhead" is figured on the normal capacity of the plant.

Of course a method of accounting does not diminish the expense, but it may show us where the expense properly belongs, and give us a more correct understanding of our business.

In our illustration of the three factories, the cost in the Chicago factory remained constant, but the expense of supporting the Buffalo and Albany factories in idleness was a charge against the business, and properly chargeable to profit and loss.

If we had loaded this expense on the product of the Chicago factory, the cost of the product would probably have been so great as to have prevented our selling it, and the total loss would have been greater still.

When the factories are distinctly separate, few people make such a mistake, but where a single factory is three times as large as is needed for the output, the error is frequently made, with results that are just as misleading.

As a matter of fact it seems that the attempt to make a product bear the expense of plant not needed for its production is one of the most serious defects in our industrial system today, and farther reaching than the differences between employers and employees.

The problem that faces us is then first to find just what plant, or part of a plant, is needed to produce a given output, and to determine the " overhead " expense on operating that plant or portion of a plant. This is primarily the work of the manufacturer, or engineer, and only secondarily that of the accountant, who must, as far as costs are concerned, be the servant of the superintendent.

In the past, in almost all cost systems the amount of " overhead " to be charged to the product, when it did not include all the " overhead," was more or less a matter of judgment. According to the theory now presented, it is not a matter of judgment, but can be determined with an accuracy depending upon the knowledge the manufacturer has of the business.

Following this line of thought it should be possible for a manufacturer to calculate just what plant and equipment he ought to have, and what the staff of officers and workmen should be to turn out a given profit.

If this can be correctly done, the exact cost of a product can be predicted. Such a problem cannot be solved by a cost accountant of the usual type, but is primarily a problem for an engineer, whose knowledge of materials and processes is essential for its solution.

Having made an attempt to solve a problem of this type, one of the most important functions we need a cost system to perform is to keep the superintendent continually advised as to how nearly he is realizing the ideal set, and to point out where the shortcomings are.

Many of us are accustomed to this viewpoint when we are treating individual operations singly, but few have as yet made an attempt to consider that this idea might be applied to a plant as a whole, except when the processes of manufacture are simple and the products few in number. When, however, the processes

become numerous or complicated, the necessity for such a check becomes more urgent, and the cost keeper who performs this function becomes an integral part of the manufacturing system, and acts for the superintendent, as an inspector, who keeps him advised at all times of the quality of his own work.

This conception of the duties of a cost keeper does not at all interfere with his supplying the financier with the information he needs, but insures that information shall be correct, for the cost keeper is continually making a comparison, for the benefit of the superintendent, of what has been done with what should have been done. Costs are valuable only as comparisons, and comparisons are of little value unless we have a standard, which it is the function of the engineer to set.

Lack of reliable cost methods has, in the past, been responsible for much of the uncertainty so prevalent in our industrial policies; but with a definite and reliable cost method, which enables us to differentiate between what is lost in manufacturing and what is lost in business, it will usually become easy to define clearly the proper business policy.

CHAPTER V

STATISTICAL REPORTS FOR THE CHIEF EXECUTIVE

INTRODUCTION

ADMINISTRATIVE control in a business establishment centers in the chief executive, who may be the president of the company, the treasurer, the general manager, the senior partner, or, in a small business, the proprietor. To the chief executive is intrusted the responsibility for the execution of policies. He is expected to maintain the essential balance of departments in order to insure smoothness of operation and maintenance of quantity and quality of product and quality of service to customers. Upon the effective execution of consistent policies depends the continued success of a business.

Executive control, to be effective, must ordinarily be based in part upon a system of reports and records which show exactly what is occurring in each department and bring out the tendencies of the business as a whole. Whereas reports have been considered up to this point chiefly from the points of view of the superintendent, department managers, and foremen to whom the supervision of the various departments is delegated, attention is now to be directed to the summaries of these records and to the statistical reports which should be prepared for the chief executive.[1] Although the form of the reports and the details included will, of course, vary greatly according to the nature and size of the business, the fundamental principles involved in the preparation of reports for the executive are essentially the same, whether the business is large or small and whether it is a retail store or a manufacturing company, a bank or an insurance company, a railroad or a telephone company.

In the first place, it must be recognized that the reports for the chief executive must be simple and condensed. Too many or too

[1] Financial statements and cost reports are not included here, for they are considered as falling within the province of accounting rather than of statistics.

elaborate reports are as bad as no reports. In instances where a properly selected system of reports for the executive has not been worked out and a heterogeneous mass of reports is constantly supplied to him, it generally happens that many of the reports receive scant attention. The executive is too busy with other matters to spend his time in ploughing through a mass of details which could have been presented in summary form. He needs reports prepared especially for his purposes. If these summaries indicate the need of more detailed information from any department, it is always possible for the executive to secure the detailed reports and records from which the summaries were prepared. The summaries for the chief executive should enable him to detect irregularities which call for further explanation, and to judge tendencies affecting the business as a whole. To the regular reports may be added summaries of the results of any casual tests or occasional experiments in which the executive is interested.

The system of reports for the chief executive should provide for daily reports of some items, weekly reports of others, and monthly summaries of others. The frequency of each report must depend upon its bearing upon the determination and execution of policies. In addition to the reports which provide statistics concerning the internal workings of the business, external statistics, especially those which are indices of general business conditions, are also required by the chief executive. The barometer figures for the individual business may be continuously compared with other indices of business conditions, such as those which have been discussed in a previous section of this book. It is not necessary again to enter upon this subject at length.

In the following selections a few illustrations of statistical reports for executives are given, but unfortunately there is an even greater dearth of published information on this subject than upon sales and factory statistics. Inasmuch as no specific example is given in the following selections of a complete system of reports for a chief executive, the following plan is outlined for purposes of illustration. A system of this sort would apply to a manufacturing company, such as a shoe factory, textile mill, or

foundry, which is turning out standardized products. The same general scheme is applicable, with some modifications, to other manufacturing companies and an analogous scheme would apply to a mercantile business such as a wholesale house or a department store. These reports for the chief executive are, in the main, summaries of the more detailed reports discussed in the preceding sections of this book.

Daily reports: Orders (number and value), Production (quantity), Shipments (quantity or value), and Delinquent Deliveries (number and value). This last item is added because the mere fact that it is being constantly reported to the executive will tend to have a salutary effect upon the whole organization and help to keep the volume of delinquencies at a minimum. A daily record of the first three items should suffice to show the general tendencies of the business from day to day, at least so far as these tendencies are revealed by statistics.

Weekly reports: Total Orders for the week, Total Orders to date (since beginning of season or year), Unfilled Orders, Total Production for week, Total Production to date, Man-hours (total and percentage of normal) or Machine-hours (total and percentage of normal), Spoiled or Second-grade Product (quantity and percentage of total production). Two of these items, it is to be noted, are totals of daily figures. For comparative purposes it is ordinarily desirable to include with these weekly reports statistics for the Total Orders received during the corresponding week and the Total Orders to the same date in the preceding year. The production figures may likewise be compared with the corresponding figures for the preceding year, or, if a schedule has been worked out, with the schedule.

Monthly reports: Orders for each class of product (total for month, total to date), Orders by sales districts (total for month, total to date, and comparison with quotas), Returned Goods, Production by departments (total and percentage of normal), Materials Used (total for month and total to date), Material on Hand, Stock in Process (for these last three items figures should also be given to show the increase or decrease over the preceding month), and Labor Turnover. For several of these items

statistics should also be given for the corresponding period in the preceding year in order to facilitate comparisons.

The monthly reports should be presented in a form which enables the executive to compare the results for one month with those for preceding months. In many businesses, where the demand is seasonal, "peak loads" occur regularly in certain months and one of the problems which faces the executive is that of lessening the distributing influence of peak loads upon his organization. In the case of local public service companies the peak load is a matter of hourly fluctuations, and for such businesses the problem is to secure a more nearly even load throughout the day. With whatever periodicity the peak occurs, the success of a policy that seeks to bring about a readjustment can be determined only from exact records which permit continuous comparisons.

A set of reports such as is outlined above will give an executive a knowledge of the main facts about his business so far as they are represented by statistics. Many of these statistics, as a general rule, can advantageously be presented in graphic form. From these reports general tendencies should be revealed and irregularities detected. The reports should indicate whence more detailed statements can be obtained for each period.

Several articles on statistics utilized in the administration of railroad and other public service companies, which indicate the analogous use of statistics in various kinds of business enterprises, are included in this chapter. Although the statistics used in the various departments of these other businesses have hardly been touched upon in the preceding chapters, the summaries here presented show that the fundamental principles of statistical theory and method which govern sound statistical practice in mercantile and manufacturing businesses are of general application.

I. The Importance of Leadership [1]

By H. L. Gantt

The great war in Europe is making increasingly clear the superiority which autocratic Germany had over democratic England in organizing both for industrial and military efficiency. If democracy is to compete successfully with autocracy in the long run, it must develop organizing and executive methods which are at least equal to those that have been developed by autocratic Germany.

This war is teaching us many lessons, but the one that stands out preëminently is the necessity for leaders who not only know what to do, but how to do it.

England, reposing in the security of her island home, and surrounded by waters that are not only a defence, but a source of wealth, had not seen the necessity for that leadership which alone is capable of organizing and training men for industry and for war, and now finds herself at a sad disadvantage when confronted by a nation whose main business for the last fifty years has been to study its industrial and military problems, and to train men to solve them.

There are indications that we would, in many respects, be in the class with England, if we should suddenly find ourselves confronted with her problems.[2]

Feeling secure in our national resources and native ability, we have not seen the need to study our problems of industrial administration from a scientific standpoint and to train our leaders accordingly, for the reason that we have attained great wealth without them — and in the minds of many the attainment of wealth is the end of all earthly things.

Here, again, the war comes to our aid, and tells us that in war only leadership and training are effective against leadership and and training, and that wealth is useless unless we have time and ability to mobilize it; so, in industry we know that a proper

[1] *Engineering Magazine*, April, 1916, pp. 1–5. Reprinted by permission of *Engineering Magazine*.

[2] The truth of this statement is only too evident now that we are in the war. [Editor.]

policy is of far more importance than the size of the plant, or the amount of money invested.

It is imperative, therefore, that our industrial leaders should be able to formulate correct policies, which must be based on fact and not on opinion, as has been too often the case in the past. Our industrial leaders must therefore be able to distinguish between an opinion and a fact. They should also be able to determine and use facts, and thereby anticipate the future and provide for it.

It was this ability which enabled the Germans to gain such phenomenal successes, and it was the lack of this ability on the part of the Allies that forced them on the defensive at nearly all points; illustrating the fact that we can no longer blindly follow the trail of those who have gone before simply because they were successful, for what spelled success yesterday may spell failure tomorrow.

Our industrial leader must be continually acquiring knowledge, and just as continuously using it to correct his policies. This is common engineering practice as far as design and construction are concerned, but far from common where the operation and the direction of human activities are concerned.

A realization of this fact is the origin of the present widespread interest in the art of management, which is simply an attempt to apply to the subject of management the method which the leading engineers have already so successfully applied to that of design. It is only natural in the attempt to make such an application that the degree of success will, at first, largely depend upon the ability and training of the engineer undertaking the problem, but the day will come when the principles underlying the managing mechanism for an industry will be as clearly defined and as well understood as those underlying the design of a steam engine, or an electric generator.

It is the function of the engineer to discover or develop these principles. This is not an easy job; for the human factor is the prime one to be considered, and many well-intentioned people have not yet learned that the man in overalls does not differ essentially from the man in the silk shirt.

During the visit of the American Society of Mechanical Engineers to Germany in the summer of 1913, the high estimation in which the engineer was held in that country was evident on all sides. There, he is looked up to for the solution of all their industrial problems, and is no doubt largely responsible for the rapid industrial progress of that nation. Recognizing the importance of the educated engineer, and realizing that unless he had equal rank with other professional men he would not have the influence that he should have, the Germans invented the degree of Doctor of Engineering and bestowed it liberally, with the result that the new profession soon took rank with the older professions in the estimation of the people. We found many of the highest civic positions held by the leading engineers. What could be more appropriate in an industrial nation?

The results, so far, of the great war have justified this policy, and the sooner we realize that the engineer is the one man who has the proper elementary training for industrial leadership, the sooner will the proper methods of developing our industries be determined.

We claim to be an industrial nation. I feel we are only just beginning to be an industrial nation, and shall not be fully entitled to that name until we have a complete knowledge of the principles on which successful industry is based.

Too many of our enterprises are still founded on what has been done rather than on what can be done. The real industrial leader must be guided by future possibilities rather than past performances.

So far, the training of executives in democratic countries has been left largely to chance, and in few cases have the principles by which successful executives must be guided been even vaguely comprehended. If democracy is to survive in the competition with highly developed autocratic methods, these principles must be understood and the essential qualities of leadership inculcated.

The widespread attempt of people to abolish special privilege will be successful only when the efficiency of those making the attempt is greater than the efficiency of those opposing it.

If we would accomplish this desirable object we must consider in detail the important elements that enter into it. Under a few headings I have pointed out the subjects that must first be given attention.

Opinions and Facts. First, let it be said that the object of all advanced manufacturing methods is to base actions on knowledge, and, as far as possible, eliminate opinion as a guide. In other words, the Committee, or Debating Society method is, under the best manufacturing methods, rapidly giving way to scientific investigation as a means of obtaining knowledge. It is essential for the highest success, therefore, that the manager be thoroughly familiar with the method of making a scientific investigation and readily capable of separating opinions from facts.

Old and New Methods. When the master mechanic owned his little shop he took the responsibility for making improvements and instructing his journeymen and apprentices. In our large factories of today, the owner is too far removed from the work of the shop to assume such responsibility, even if he were capable of doing so, which, as a rule, he is not. What has he done to fill this gap? One portion of the work, that of invention and design, has been well filled by the graduates of our engineering schools. The other, that of increasing the efficiency of the operation of his shop and the training of his employees, he has, as a rule, left in the hands of foremen already so overloaded with routine work that they are usually unable to get things done as well, or as cheaply, as they know they can be done.

In the little shop of the past, the owner carried all the details of the business in his head. As the shop became larger it was necessary for him to delegate some of his duties to others, and the best systems of management of today are so designed to coördinate the functions which have been delegated in such manner as to make them as effective as when they were all united in the mind of one man.

Manufacturing System. In other words, the manufacturing system is designed to take the place of the one-man management when the plant has outgrown the ability of one man to know all about it. The manager must understand thoroughly how to develop and operate such a system.

Such a system may be likened to a man with a perfect memory and an infinite capacity for work, who has complete knowledge of all the tools in the factory and is familiar with the best methods of using them; who makes it his business to learn all about new methods and appliances as fast as they are developed and to see that they are efficiently utilized in the factory.

To inaugurate such a system we should have in the manufacturing office a complete knowledge of the shop equipment, a running balance of stores and of finished parts, and means for knowing at all times the exact load on the shop and how each detail part of it is being handled.

Such an office must receive all orders for the work to be done, and issue detailed instructions to the different departments, checking up each day the work that was done the day previous. In order to do this satisfactorily, it must contain all the information regarding the tools and appliances that the various foremen usually carry in their heads. If we know what is to be done and the means available for doing it, it is possible to plan the work in advance, but it isn't easy. Proper planning, with returns each day to tell us how our plans are being carried out, is a far more effective method of reducing costs than the post mortem information furnished by a cost system, provided the superintendent makes full use of the information. If he has not the ability to plan and to lead, he will get but little benefit from this system, which is designed to enable the capable man to exert a larger influence in leading and directing.

One of the great obstacles in the way of introducing these methods is that they require that every man shall bear his own burdens. If the position calls for a leader, the man filling it must lead, he cannot simply " hold " his job, as is too often the case under the older systems.

Principles. We might, as has been done by others, enumerate several principles on which successful management is based; but, if we confine ourselves to one cardinal principle, the acceptance of which seems to compel the acceptance of the others, we may be able to impress our readers with its importance. Such a principle is: THE AUTHORITY TO ISSUE AN ORDER INVOLVES THE RESPONSIBILITY TO SEE THAT IT IS PROPERLY EXECUTED.

This one sentence can be made the subject of a long essay. Adherence to this principle eliminates that class of managers, unfortunately too common, who like to shift the responsibility for their errors to their subordinates. By the elimination of such men, authority gravitates slowly, but surely, to those with knowledge, and we finally have a condition in which authority is based on knowledge and ability to use that knowledge.

The most important corollary to the above principle is, that a man given an order is expected to carry it out, and is thereby given the authority to remove any obstacle he may find in his way.

In other words, orders are given to accomplish results, and they should be given only when the results are possible; in such a case no excuse for failure should be accepted.

It cannot be too strongly emphasized that the one object of a factory is production, and that all other factors are secondary.

So far, our colleges and our training schools have failed to impress this fact sufficiently on their students, and have too often contented themselves with imparting technical knowledge and skill. To use that knowledge and technical skill to produce economically is a far more difficult subject to teach, but it is the one that is pressing for comprehension.

Costs and Expenses. There is a haziness in the minds of many people as to the difference between costs and expenses. Some people claim that all expenses incurred in accomplishing an object should be included in the cost of doing it, regardless of the fact as to whether they contributed to the end desired or not.

Is it not time that we separated the necessary expenses from the unnecessary ones, calling the former the cost, and the latter by some other name?

In any enterprise, money wasted by misdirected energy, or by improper policy, is not a legitimate charge on the enterprise, but should be charged directly to the management as a loss. Heretofore, such waste has been included in the cost of the enterprise, the blame for the excessive cost of which has too often been laid on those carrying out vague instructions, and whose actions have been governed largely by improper policies of their superiors.

As long as we adhere to the old method, and include in the cost of doing work the expense of energy wasted by improper direction, we shall be unable to place blame for failure where it belongs. The newer cost ideas separate these two classes of expense, and give us a measure of managerial efficiency, which has been largely lost sight of in the past, as well as of operating efficiency, which has been in the limelight for several years.

The argument against this is that "it can't be done"; the answer is, "it is being done."

Leadership. All great movements, whether for good or for evil, originate in the mind of some leader, and so important is this man that these movements are often known for thousands of years by his name. Christianity, Mohammedanism, and the other great religions of the world bear testimony to this fact.

All great inventions and enterprises not only have their origin in the mind of some leader, but they must be carried out under competent leadership. There is no factor that comes to the front at so many points as leadership; for it is not only the man who conceives the idea of an enterprise that must be a leader, but so must be all of those under him who have to direct the activities of other men. The manager, the superintendent, and the foreman must all be leaders if they would get the best results. This is true all over the world, but more especially in America, where every man has a right, so long as he conforms to the laws of the state, to do that which serves his interest best.

If, therefore, we would stand at the head in industry, we must develop such methods of training our leaders as will enable them to command the confidence and support of the men with whom they have to deal.

This subject has been given but little attention in the past, and in consequence our leaders have been largely selected at random, with the result that there are in this country no generally accepted principles of industrialism along the lines of which advancement can best be made.

Not until we have determined the principles on which industrial development must be based, and accepted the lines along which our leaders must be trained, can we expect any harmonious

development. The great war now being waged in Europe has enabled us to contrast a great nation where industries were thus harmoniously developed with one whose industries have been developed in the haphazard manner which we seem to cherish so highly.

This war is destined to be the most far reaching event that has taken place since the fall of the Roman Empire, and many methods which were in vogue when it began will be as obsolete when it ends as the dodo.

If we would keep our place in the new world, which is to be created by this war, we must learn our lesson as it progresses, and train our people accordingly.

II. The Hardest Question in Business [1]

By Carroll D. Murphy

"That's the hardest question in business," exclaimed one of the half-dozen managers of distinguished enterprises recently asked to list the vital factors of control in an organization — to take apart the enterprises they have brought to success, and point out the ideas, policies, methods and results which seem to them so important that the chief himself should have them under his eye and hand.

Varied as were their replies — personal, keen, widely different in approach to the problem — yet throughout runs this central thread of management: that detail must be organized and everyday results made automatic; that the executive must keep proper perspective; that a manager's work is not to shoulder many little tasks, but to develop men and systems for present routine, and thus reserve his energies for the greater plans, decisions and initiatives on which the future is to be built.

"The measure of a manager's value," said Clarence Funk, "is his ability to put men in charge of his various departments who are stronger men in their lines than he is." "I expect to put in half of each day at the office after I am dead," Cyrus K. Curtis once said, humorously hinting at the organization of men and

[1] *Library of Business Practice*, vol. 1, pp. 9–24. Reprinted by permission of A. W. Shaw Company.

detail by which he gets things done present or absent. "The important thing," another skilful manager often says, in explaining his ability to extend his oversight throughout a great business, "is to distinguish significant from trivial detail." "I won't let detail get to me on any terms," replied J. S. Kendall in explaining how he sifted the important from the negligible. "The immediate loss from a small blunder is insignificant and I pay certain employees to analyze the day's work of the concern so that I can stop cumulative losses."

William A. Field's answer makes the same point, but in the nature of a warning to employees who aspire to managerial places. "Young men," he said, "try to handle too much detail and are crushed beneath their load." From his own experience, Edward B. Butler carried further the same hint to manager and men: "It is hard to get a man to let go of detail — to grow up into control — to think for his subordinates who do not think."

In his management John G. Shedd would subordinate personal initiative to nothing else. "Energetic originators in merchandising," said he, "may be stifled by surrounding them too thickly with figures and regulations. . . . Going beyond a reasonable limit with statistics may kill the Napoleons of business." The strength which this composite initiative — the enthusiasms and energies of manager and men working together — gives to a business was neatly brought out by W. E. Clow: "I hire men to make me hump."

The great essentials of a good manager are brilliantly summarized by two other men in control of great enterprises. "I want executives," E. A. Filene often says, "who can think straight, handle men and buy money well." "Successful men," E. P. Ripley has said, "have always known how to organize, supervise and deputize."

The battle with detail and the problem of shaping men to your work — freedom from routine and sure contact with essentials — getting today's business done and planning a secure, progressive future — are suggested by all these executives as the essential aims and the true viewpoint of the manager. Closer study of the lines along which the ambitious employee, the personal proprietor

and the corporation executive must work shows that the three great business mechanisms which the manager must control are men, money, and service. According as different concerns emphasize one or another of these factors in their schemes of management, policies of executive control may be roughly divided under five headings: —

(1) *Detail Management.* Most managers are driving themselves to their physical limit in the handling of the details of service, employment and especially finances. Some executives have been literally crowded out of this position by the growth of the business and have taken a stand at some point along the current of trade, where by watching every order, every credit, every contract or expense item, they can fairly judge and control the business.

(2) *Money Management.* Many proprietors and directorates guide their businesses entirely by ledger statements and throw upon subordinates hired to round out their ability all other matters relating to the conduct of the enterprise. In one case a directorate which is managing a business entirely as a matter of investments and profits has never seen the chain of stores from which its dividends come. A detail manager pledged to enthusiasm by a generous salary has authority over everything except financial policies. The disadvantages of this plan are that there is no proprietary control of the methods used in dealing with the trade, nor of the spirit among the men; the business runs at high speed but roughly, with much jarring; and the management has too little real knowledge of conditions to forecast the future most effectively.

(3) *Leadership Management.* Encouragement and the rousing of enthusiasm among employees is the contribution this type of manager makes to his business. His is an enterprise that requires extraordinary initiative; his men have to be keyed up to the fighting spirit — they need the " flaming torch " to lead them. Systematized routine is, therefore, left to handle problems where a solution has been found and a precedent established. The management devotes itself to " breaking trail " in every new and difficult path of the enterprise.

(4) *Guiding Management.* Some managers and directorates put their entire organization as a tool in the hands of their most brilliant executives, advising and aiding them to carry out for the profit of the concern whatever inspirations promise best or to exercise the particular genius of each. This is the type of business where the manager occupies a broad field and insists only on dividends rather than confining his business to a definite product or service. This policy is especially the recourse of a concern which has outgrown one line — the big business viewpoint, where the manager has perhaps realized his visions and depends on the inspirations of his men for further expansion.

(5) *Balanced Management.* Rockefeller's success is credited to the poise which he has always maintained in his corporation. In a business so balanced, neither men, money nor service has undue emphasis; no one department or method is allowed to excel or overtop others, but every part constantly learns from other lines, constantly is kept up to the mark and in proportion with all others. This type of management combines the last two and rounds out the incompleteness of all; the manager is not only a constant inspiration of all departments, but makes full use of whatever inspiration he can draw from his subordinates. He realizes the necessity of neglecting no present essential — neither men, investment nor service — and has so organized his method of securing reports, making brief studies in his various departments and arousing a partnership spirit among his men that he is free to dream ahead and plan a greater future for the enterprise.

Most men fall short of managerial success because they are one-sided. All of us have seen the proprietor who allows himself to be flattered on his weak points, equips himself with subordinates who duplicate rather than round out his abilities, and dodges haphazard through each day's detail with no distinct scheme of management.

The problem of breaking away from this condition has been solved in a suggestive way by the manager of a real estate business that last year sold more than four million dollars' worth of property. This executive recently sat with a wholesaler in the latter's private office. Ten times within a half-hour their talk was dis-

turbed by salesmen coming in for O. K's on routine credits. "You cleared a quarter of a million this last twelve months, didn't you ?" the real estate man asked his friend. "Why not take six, eight, ten thousand dollars and hire an assistant who can sweep this detail off your desk and let you get at the bigger questions of your business ?

"What subordinates will handle your task — what insurance have you made for the care of your family's property — when you can no longer do this pell mell day's work ? One-third of your time, if you will figure up your own labor costs day by day, is spent as nothing but a routine credit manager."

"But I can't find the men," protested the wholesaler.

"You don't know your men," was the answer. "One of them I think so well of that I have been figuring with him on a similar position in my company."

A week later the wholesaler spent a half hour in the office of the real estate chief. The latter closed the door, sat down at his desk, reached under the edge of it and touched a buzzer once. "That means," said he, "that I am busy and do not wish to be interrupted. I pay my secretary one hundred and twenty-five dollars to know that now she is to take the numbers of any telephone calls for me, to round up any matters I need to go over this evening and to get to me if something of prime importance turns up.

"Five years ago," he went on, "I was at this desk until eleven o'clock every night, going over contracts and ledgers. My business dropped off because my selling force had no head. Then I stopped — took the time to analyze my business and find what went into my job as manager."

This actual occurrence throws into sharp contrast what I have called detail and balanced management. Hundreds of such illustrations are at hand even among million dollar concerns. Routine-burdened proprietors insist upon O. K'ing every item which touches expenses or a contract, and thus take away the initiative of their men, interfere without full knowledge in departmental work and neglect to grasp the loose reins of company spirit, present service and future progress which lead up to their desks.

One executive has arranged that no contractual letter is valid without his pencil mark in the corner. Another has a hobby of picking up ideas among other plants, which he so forces upon his department heads that they " make believe " to use them even when valueless. A third executive who is strong as a salesman is constantly interfering on the artistic side in the making of his product, although his judgment on art is a joke.

Study of the work of high executives indicates that they need a background of detail experience and that in emergencies they may have to handle the work of a department, but that they study themselves as frankly as their employees and use their resources to hire men who shall round out their own abilities. Skilled lawyers are constantly at the service of department heads in order to guard contracts; and technical men in a dozen different lines are kept available by various managers who recognize, as Funk has said, that their greatest value is in securing an coördinating expert service.

Money management is an extreme of this type. There is in New York a body of men whose ability to manage money is drawing dividends from a score of middle western stores into which none of them has ever stepped. Of buying, of working with men, of planning for expansion and choosing " good towns " for additional branches, they know nothing. This ability they have bought in the person of a trusty auditor and an experienced superintendent. They have limited the business to a cash basis, held down administrative problems to a minimum and are enabled to control successfully merely by holding the strings of local and total reports, capital and surplus, purchases, sales and expense, profits and dividends. By comparative and graphic financial reports, they are shaping the future of a business in which capital is the big factor. Their method has been to reduce men and service to their lowest terms and shrewdly to pick out the essentials in the control of funds.

An entirely different spirit is behind the policy of the manager who heads and inspires his men. He may have the other factors, finance, service, future plans, well in hand, but his biggest duty, as he sees it, is to lead his men — to teach them that he asks them

to go nowhere except where he will go first. He has worked out a course which his enterprise is to take, and in order to keep close to it, he goes first. Usually such a leader comes up from the selling side — a Chalmers, a Cottingham. He suits the enterprise where production is automatic or routine; where financing has been solved; where the packages that stream out to the shipping platform crowd the salesmen in their efforts. When, however, a mere field leader happens in control of an intricate producing machine, his instinct for fast work, attractive selling points, and competition among men may lead to an emphasis on appearance rather than quality and on the impossible promises of delivery which mark the business that is out of balance.

The manager who guides instead of leading and furnishing inspiration for his enterprise is making the best of a temperament judicial rather than executive. He hires department heads who are full of ideas but perhaps lack the ability to separate the good from the bad business propositions. His men furnish many ideas and inspirations; he guides their ambitions, challenges the visionary enterprise and backs his workers in carrying out their plans.

At his best, he attracts to himself partners or subordinates who so round out one another's powers as to make for extraordinary efficiency.

The directorate of a great railroad is said invariably to follow this method in filling the president's chair. Periodically the effectiveness of the system in all departments is discussed. The most recent executive has come up through the engineering or operating or selling department, and in line with his natural bias has brought that function to extraordinary efficiency. Striking a level throughout the corporation, another department far from his experience shows at low ebb. If an executive can be found with the qualities of a manager and with experience in this weak department, he is elected to the presidency, and the business is thus made continually to race with itself.

In a similar way, it is possible for you as a proprietor, as an executive expectant of advancement, or as a member of a governing board, to test your perspective upon the men, the capital and

the service under your control so that no possibility will be neglected.

A manager who, at twenty-nine, controls a half-million dollar business of his own, hit upon the plan of telling the department head who broaches a suggestion: "You know I can't remember any of that. Better put it down on paper." This is more than a way to minimize his detail work — it is a definite scheme of management in its first essential — to develop managerial ability among subordinates. Suggestions now come to him on paper, carefully worked out, with a plat of the location involved, and with the cost, upkeep, income, addresses and all details in order.

Every executive knows how difficult it is to get men to put cases before him briefly and yet so completely that he can make a clean-cut decision — so that he can manage rather than investigate and administer. This executive has learned to insist upon a statement that not only lengthens his own reach, but trains employees to recognize essentials and to push secondary control to the limits of their authority.

Further, he sends his department heads anywhere from Los Angeles to Boston upon hearing of any concern which is doing something better than his office has learned to do it. Every business has done some one thing better than most others. This manager has learned to go prospecting by proxy and so get the gold of progress in many lines. His own ability is lifted upon the platform of all that his men learn, suggest and achieve.

Seven out of the ten well known managers quoted have suggested the importance of developing initiative, mental power, enthusiasm and team spirit in the force. This is characteristic of the manager who realizes that neither detail nor policy can be realized except through subordinates. Scarcity of men — the time-worn excuse of overworked managers — often goes back to the chief's neglect of the men in his employ.

Detail gets power over business executives because (1) they cannot separate the significant from the non-essential, or (2) they cannot so organize as to get other than eye service.

"One of the hardest things for an executive to learn," a sage business man has said, "is that while his men are developing, he

may expect nothing to be done exactly as he would do it. He must permit mistakes to 'go through' if his men are to see where they have blundered."

Another efficient manager has a creed something like this: "An office manager, a private secretary and an experienced lawyer checking over and summarizing the work of this concern prevent the making of any mistake so important as to endanger our business. For lesser mistakes I throw the responsibility on my men and, by my various reports, afterwards get at the blunders which indicate dangerous tendencies and require that I train or correct my men." This system of reports brings out the relation of every employee to finances as regards sales, expenses and profit; to service, as regards all correspondence, but especially contracts and complaints; to new plans and opportunities, and to team spirit and office discipline.

What he calls his "mail analysis" will illustrate his method. His secretary goes through both the incoming and the outgoing mail every day and makes a four o'clock report to him somewhat as follows:—

Daily Mail Analysis

Incoming mail
- 80% routine
- 10 buyers make various complaints as to service rendered
- Three misdirected letters returned
- Terms offered on Harris contract
- H. F. sends $5,000 contract for signature.

On this report the chief checks any correspondence he wishes to see. Important outgoing mail is thus brought to his attention before being posted. Less important letters which are not tactfully written will result in complaints and thus be called up later, as "kicks" are among the points most carefully watched. In a few minutes he makes all important letters safe, and checks on the efficiency of every correspondent and stenographer. A monthly report arranged by quotas and actual totals tells him just how each department's expenses, sales and profits are running. Other details are similarly sifted.

Guessing at financial trends is one of the worst blunders a manager can make — and, strangely, one of the most frequent.

One day the manager of the real estate department in an investment company went to a successful competitor in desperation and asked for his scheme of accounting. The real estate department was one of three subdivisions of the business which, taken together, had shown a fair profit. "I'll wager," said the competitor, "that your department has not made a dollar in three years."

Analysis along the lines of sound cost keeping proved that in thirty-five months, with an investment of $1,500,000, the department had lost $200!

Money is never still. It is always either coming or going; growing or wasting away. Your desk of control is ill-equipped unless to it come daily, monthly and annual reports which tell you in itemized detail, with whatever quotas, comparisons and percentage parallels are most helpful, your cost of doing business, the relative parts in that cost which men, material and other factors play, your various lines listed in order of greatest per cent and total profit, your income, your turnover, your investment, your depreciation, your quick assets and liabilities, your collections and reserves, your profit or loss.

Every business, moreover, has some factor which is as sensitive as a barometer in reflecting current conditions. You need to find and watch this essential constantly. Credits, collections, overhead, trend of buying, raw material prices, money rates, labor prices, drift of working or trading population, may be the point that requires special attention. Financial policy needs also to be determined as regards the confidence of the public and the banks in your integrity and as to good credit, expansion from profits and the avoidance of investments that make your business top-heavy.

"Some details are as important as the totals on the bank statement," is the viewpoint of one manager. The details he referred to are those which touch the firm's relations with its public. This executive from time to time inspects his shipping room and returned goods department in order to get at the causes that lie behind complaints, misshipments and damaged goods. Another millionaire owner is known to have claimed in person rewards offered to customers who detect a blunder on the part

of the salespeople in the arrangement of stock. A third proprietor makes a cross-section study of his business by getting down early Monday morning and going over the two days' mail in detail.

Among the vital functions of management are these: to decide finally what the public demands; to know what is given them in goods and service; to bring future demand and supply into harmony; to focus into a policy the workmanlike care of the production chief, the credit man's distaste for risks; the collection manager's temptation to collect money at the sacrifice of friendship; the salesman's tendency to get orders regardless of final satisfaction. As subordinates come and go, your business cannot keep on an even keel unless you balance all the different forces in action and hold to a steady course. Find out, therefore, why you are in business. What is your special right to expect trade? Why should prospects come to you rather than to your competitor? What classes do you expect to serve and how? Almost every enterprise has been built on a service idea — the Wanamaker one-price retail plan, the Butler one-price wholesale service by mail, the unit idea, the department store policy of convenience, the Marshall Field axiom that "the customer is always right."

If you get a definite basis for your business, it will not be hard to organize your accounting, cost keeping, orders, complaints and testimonials, so that from day to day you will know whether your policy is still right and if you are still selling satisfaction.

Beyond the policies of your business, out of the analysis of past trade, looms the biggest job for the man at the manager's desk — watching the road ahead, charting progress. You have busied your employees with detail — make sure that you plan ahead. The big lines of policy and control which focus at your desk lead out from yesterday into the tomorrows, and only the man who has them in their proper perspective can plan for the future.

One manager keeps on his desk maps and plans which require years to work out — the raw material of future business. When he has tested them in all his moods and has worked out the capital backing, the customer demand and the proper employees for

detail control, he sets itemized quotas for every man in his business; to which quotas in several years no employee has failed to measure up in total and item by item. He has gained his men's confidence by sound judgment and successful campaigning — has established himself in leadership by long hours of poring over policies, financial and labor conditions, credits, competition and opportunities of service.

Management is not only the hardest problem in business, but the problem that comes nearest to the secret of failure and success. Up at the top of every business — at the apex of its pyramid of functions — sits some one to whom all lines, wires and paths of communication lead; where focus problems, records and plans; from whom radiate the spirit, the policies and the initiatives which are to write in the future of the enterprise. No other desk is so hard to fill, because no other man must be so well rounded and evenly poised.

No special knack or ability will make a manager without self-training and use of the abilities of others. List, group and analyze, therefore, the work that fills the calendar of successful managers — that goes on at your own desk. Reduce your detail to system and assign it to subordinates. Find out what fact, what tendency expressed in a dozen letters, conferences or sets of figures, tells you something vital — get that point and delegate the rest. The subject matter of your day may be different as your business passes from the little shop through the transition stage where it is too big for intimate daily supervision and finally into a strong corporation. The witness of successful managers is, however, that at every stage they are outside of and bigger than their business — above it, and in control.

III. Driving the Engines of Business [1]

By Kendall Banning

Compare the picture of the head of a big business concern, on duty at his executive desk, to that of an engineer on duty at his engine, surrounded by appliances that not only regulate the

[1] *System*, December, 1908, pp. 548–556. Reprinted by permission of *System*. Illustrations of charts are omitted.

machinery but keep him in constant touch with every part of the work which the machine is doing. Compare the call buttons on the executive's desk, his various telephones, his graphic record and organization charts, his daily-duty card cabinets and more particularly his daily, weekly and monthly report folders on finance, labor and production, to the power and fuel indicators, speedometers, gauges and controllers of the engineer; and we get a picture of the real functions of a business executive.

The simile may be carried out into many picturesque details, up to this one all-important point of comparison — that while the engineer can merely attain the uniform mechanical efficiency of that machine on a fixed schedule, the business executive has unlimited scope in the selection and construction of his engine of business, unlimited choice of routes and speeds and unlimited range of action and selection of goals toward which he may drive — goals that are limited in their importance only by the capacities for organization of the guiding force.

Therein lie the opportunities that have been seized so conspicuously and so dramatically by the great American executives, who have built and driven American business organizations over uncharted roads to the most commanding positions that the world of trade has ever known.

The business executive, like the engineer, must at all times have control of his organization. The moment either loses that grasp, his machine is beyond his control. It is the business of both to see to it that their machines are operating steadily, that the various parts are keeping up their work in harmony with the others, that the wastes are eliminated, that supplies are available, that the tracks are clear. If either fails to note the signals, he will drive his engine into danger just as surely as he will lose control to the man who sees the signals the other has missed and springs forward to take command. Opportunities and dangers come to the incapable executive when he is unaware. They are anticipated by the executive whose systems of control are so fine as to let him feel every throb of his organization, every beat of his engine of business, and allow him to guide it and regulate it and know it as an engineer knows his machine.

What the Executive Has to Do — the Facts He Requires

The functions of a business executive may be classified thus: —

1. To keep in constant touch with the condition of every part of his organization through the medium of constant and special channels of incoming information from every department.

2. To originate plans or policies that affect the organization as a whole and to execute his authority in keeping the various parts harmoniously adjusted and in regulating their efficiency to meet demands.

The second of these functions must, of course, be determined by the peculiar conditions that confront each individual concern. With the channels for getting the statistics on which such executive action is based, this article deals.

An executive's systems for keeping in intimate touch with his business naturally vary in scope and complexity with the size and purpose of his organization. They range from his casual morning chat with Bill, his partner or manager or sole employee, to detailed written reports and charts made out at daily and sometimes hourly intervals to show the specific progress in dollars or in units of production of each machine of each factory department. They cover every item of information from the amount of money in the cash drawer to the percentage of costs of pin bolts in one of the shops to their costs in years past, with the reasons for the difference. They come in forms that vary from the shout across the office to elaborate charts in colors that show in graphic form the increase and decrease of a subdivision in specific detail. The simplest form is sometimes the best. Reports that are too complicated are as inimical to real system as reports that are careless and incomplete. The best channels of information are those that present the most vital facts in the most direct form, that eliminate the extraneous detail and attain their purpose in the most economical manner, on precisely the same principle that a straight line is the shortest distance between two points. The fewer these points are in number, the simpler the work of the executive naturally becomes, but the number must not be reduced to the elimination of facts that affect his efficiency.

Specifically, what are these facts?

For purposes of illustration the main channels of incoming information may be classified thus: —

1. Finance.
2. Correspondence.
3. Sales.
4. Mechanical Equipment.
5. Labor.

The fundamental point of information that is as important to the smallest as well as to the largest concern is the amount of cash on hand. The little shopkeeper ascertains this information by a glance at the contents of the till. The larger executive gets it by balancing his bank book. The still larger executive finds the information on a slip of paper handed to him by his cashier or bookkeeper. The head of a big corporation gets it on a report form made out every night to show the exact balance in every bank in which the corporation has an account, bills receivable, bills payable, securities owned and their prices for the day, and other financial data, which is laid upon his desk every morning by the head of his financial department. This information is as vital to the humblest as well as to the greatest executive. It allows both to plan their business days so that their obligations may be met and their credit maintained.

Exactly how much money is the company making or losing on each individual order? The figures are at the executive's call. In the case of the American Bank Note Company each order is given a job number. The exact cost of material, the time spent on the order in each department, even at each machine, and other data are recorded on the cost sheet. When the order is completed and the cost sheet is filled, it is placed in an envelope, duly labeled, and immediately sent by messenger to the executive. The costs of production are compared to the selling price and the profit or loss is known to a cent. If a loss is shown, the executive confers with the manufacturing and estimating departments and either reduces costs of production or boosts selling price.

From these job-cost sheets are made up the reports of weekly costs. From the reports of weekly costs are made up the reports of monthly costs. Both of the latter are compared to the corre-

sponding records of preceding years. Both are filed in leather binders and kept in the executive's office for ready reference. From them he can learn in a moment the cost of any detail on any job for any year. Similarly he gets reports every month that show the profit or loss on each order, the value of the stock on hand and figures that show the exact status of the business at the close of each month. In short, the books are closed and the annual statement is made up, for the executive's attention, twelve times a year.

The head of the Regal Shoe Company gets this information in more graphic form from his statistical department, where all the records and reports of every department are concentrated and whence they emanate in analytical colored charts which are presented to the executive in tabloid form. A few years ago information concerning the various departments was brought to the executive's attention by the heads of each of these departments. As the departments grew, these reports multiplied into hundreds. The executive was no longer able to extract the data needed. This work is now attended to by a department established for this sole purpose. It supplies to the executive the charts and maps on which the future plans of the company are determined.

On this report appears all information which the executive may need in planning his day's work. It gives the estimate of sales for the first half and on the last half of the month, with the average of each day indicated. Below this appears a record of the total sales made up to date as compared to the average daily sales to date; a comparison of the total sales yet to be made in order to maintain the sales quota; a comparison with a similar record of the previous year; a record of the products of the present month as compared with the year before, and a record of the distribution of the stock in the factory, in the stores and in transit. At the bottom of the sheet is a record of the cash balance of the year before. This daily report is taken up for action by the executive the first thing every morning, before opening the morning mail. Any unusual condition is thus brought to his attention promptly and a check placed upon leaks before they involve loss.

In the same way the executive is informed of the weekly sales and expenses of each department and of each store, compared to what they were the year before. The figures representing the payrolls are indicated in barometer-like form that show from across the office what their relative size is now to a year ago. They are as clear to him as the speed or power indicator is to the engineer.

A third and more personal system of keeping an executive informed of the work of his departments is observed by John H. Patterson, the head of the National Cash Register Company. This executive practically makes the department come to him, and explain in the person of its head what it is doing. For this purpose, each department is equipped with a folding blackboard, containing one or two dozen leaves. Each leaf or page is numbered and reserved for information concerning the various duties of that department. Its output, its expenses, its changes in personnel, its suggestions for improvements, and its accomplishments and obligations are written thereon daily. A glance through it shows the status of work. These blackboards are adjusted to the walls of the departments. At the command of the executive, they are transferred to the wall of the president's office and inspected and dissected by him with the assistance of the department head.

The statistics of each department are, of course, recorded in regular form; the blackboard scheme, however, enables the executive to get directly, from the head of each subdivision, a direct and intimate review of present conditions and plans for the future that do not appear in the company's records.

Next in importance is the daily mail. The mail contains inquiries, orders, money, complaints, reports — matters on which the work of the organization rests, the fuel with which the engine is run. If the mail is small, the executive opens it and attends to the contents himself, or marks on each letter the individual or department to which it is to be referred for action. If the mail is heavy and the firm is large, the mail goes to the mail clerk or to the correspondence department, from which the letters are similarly distributed and a report is made to the executive head.

This correspondence — the incoming and the outgoing mail — is the pulse of a firm's progress with the outside world. The closer an executive is in touch with this pulse, the quicker he can detect fluctuations and administer accordingly.

A business man once wrote a request for some minor information to the American Bank Note Company of New York. A year later he met the president of the company, Warren L. Green. To the man's surprise Mr. Green recalled not only the request, but the disposition that had been made of it. Yet Mr. Green had not seen any of the correspondence. Similarly, Mr. Green is familiar with all the correspondence that reaches the company. Yet his system is as simple and compact as it is labor saving.

All letters that come to the company go directly to the correspondence bureau. This bureau consists of two clerks, who open all letters. To one is referred all foreign communications, to the other all domestic correspondence. Each clerk typewrites in capitals on the left margin of a sheet of paper, dated, ruled and perforated for binding in a desk folder, the name of the firm or individual from whom the letters come; or on the left she typewrites a brief résumé of the contents of each letter in two to thirty words. Letters that refer to financial matters are listed on a lavender sheet. Correspondence about equipments or supplies are recorded on blue paper. Communications from or about the branch houses are recorded on green sheets, letters about typography or printing on yellow sheets, and about securities or other engraved products on white sheets. Thus each of the five main divisions of the business are differentiated by their distinguishing colors. After each résumé are placed the initials of the individual to whom the letter is referred.

Early each morning these reports are inserted in a leather bound folder, the reports of the day preceding are placed in another folder with the reports for the entire month, and both folders are placed on the president's desk. A moment's glance over these reports gives him the gist of the morning's mail and enables him to select such items as he may care to take up personally.

After each delivery of mail, this folder is taken to the bureau, the additions are made, and the report is returned to the presi-

dent's desk. At the close of the day, the bureau notes in pencil the disposition that has been made of each letter, for future reference.

A third desk folder is reserved for similar reports of complaints that are made. Has there been a kick about the quality of some supplies that have been ordered? It is reported on a blue sheet. Has there been a delay in the delivery of some printed matter? It is recorded on a yellow sheet. Does a customer complain about his bill? It is noted on a lavender sheet.

In this way the executive keeps the correspondence of the company under his constant surveillance. Every letter comes to his notice, and the employee to whom it is referred knows it and acts accordingly. The system maintains the discipline of the office; moreover, it enables the president to keep a rein on the correspondence of every department.

Order, sales — the fuel that keeps the business engine running — are the easiest items for an executive to record. Mr. Green gets a record of them from a small desk-cabinet, containing dated cards, each card bearing a record of the orders received under the date it bears. Thus the cabinet is a record of orders received every day from the first of the year. From this record are made up the itemized weekly and monthly order-report sheets, showing the number and value of orders received each day from each branch office, as compared with the best record of the last ten years, the worst of the last ten years and the average.

Mr. Bliss of the Regal Shoe Company gets his record in picture form. His chart shows in varicolored inks the weekly sales of each store. It indicates the actual sales for each week for the past four months, the proportion of expenses to the sales, the sales of the corresponding week the year before, the expense of each store for the present week and the week a year ago, the number of employees, and other data that form the basis of executive action.

The chart, for example, that shows the semi-monthly records of sales, is divided into latitudinal sections to represent the store numbers. They can represent departments of a store just as well. The figures in the left column represent the increase or decrease

in any store sales, extending upward and downward from the zero point. Here are indicated the average sales for all stores and the record of each store in comparison, extending both upward and downward as it falls above and below the average. The store which shows the greatest sales appears at the left, the store which shows the smallest sales at the right. The result is a diagram like a stairway, on which the position of each store is represented by a step. In connection with this figure, the increase from the first of the season to date is indicated by a colored line on which the comparisons may be based.

On the first day of each month, another chart is brought to the executive's attention. This chart compares the month's sales and production with that of the month preceding. The numbers across the top represent the days of the month and the figures on the column on the left represent the number of sales and the production at the factory. The lines represent the sales for each day. Saturday, it will be noticed — pay-day — shows a marked increase over any other day of the week. The average daily sales are indicated by a line extending from left to right. The series of circles extending upward and to the right represents the accumulative sales and the accumulative products. The line showing the stock on hand must always run just enough ahead of the line of production to avoid delays through lack of stock. All of this information is imparted to the executive at a glance and deficiencies are brought to his attention automatically in such a way as to enable him to distribute his forces to the best advantage.

The systems for keeping the executive in touch with the mechanical equipment of his organization, especially in a manufacturing organization, are so analogous to the mechanical appliances that keep an engineer informed of the workings of his engine as to amount practically to the same thing. The self-registering charts in the latter case are permanent fixtures of the engine; in the case of the executive they are sent to his office. From them he learns of the power being used, the amount of fuel consumed, the productive power per unit of fuel, the productive power of each machine and of each employee. An indicator-chart was the direct means of saving a large manufacturing concern

$89,000 a year by pointing out the wastes in power and labor. From it the executive learned that the maximum load of the plant, amounting to 1,000 horse-power, was not used in the morning until 8 o'clock, although the plant opened at 6.45. He learned that the same condition prevailed after the lunch hour, when the maximum load was not borne until 2.30 instead of at 1 o'clock. He learned that this load began to drop at 11 o'clock instead of running up squarely to the closing hour at noon.

In like manner the load began to decrease at 4 o'clock instead of running abruptly to 5 o'clock, the closing hour. This report chart showed, in brief, that the friction load of the engine for transmission devices — belting, shafting and idle machines — amounted to a trifle over 50 per cent of the maximum power required when the plant was running with its full load. The amount of power consumed is proportionate to the machines in operation. The number of machines in operation is proportionate to the men at work. Hence, the men did not all begin work promptly and did not continue up to the blast of the whistle — a fact that investigation proved true. Similar tests can be applied to almost any department of a manufacturing plant, or to any department of a store.

The American Bank Note Company keeps a record of the work of each individual machine in its factories. Each machine of each type is numbered and a record is made each day of the operations performed by it. The time spent by the workmen in getting it ready, the amount of preliminary work, the duration of its operations, its speed, its delays, the value of the order on which it is used, and the amount of incompleted work are all represented in figures that go in tabulated form to the executive. These tables furnish all the data that an executive requires for estimating the value of his mechanical equipment and for knowing the progress of the work on each order. Does a customer inquire when his goods will be delivered? The distribution of his order through the plant, the amount furnished and still to be done may be announced to him without requiring him to "hold" the telephone.

IV. Behind the Figures [1]

By A. E. Andersen

An unexplained shortage of $15,000 in the raw material account for the year just closed led the general manager of a specialty concern through the sales, purchasing, cost and operating departments to the little registering device at the side of each finishing machine.

The product was sold by the lineal foot. The figures indicated that the material used exceeded by $15,000 worth what had been delivered to customers. No "bookkeeping errors" were found, but when the accuracy of the records had been checked and proved, the reason for the loss was found in the devices for registering the quantity of product turned out. These were out of order. For more than a year every customer had been charged for much less than had actually been shipped because the counters had "slipped." Since the gifts were of finished product the loss was nearly double the cost of the raw material.

Right figures check, guide and control any business. A suitable accounting system, matched to the size and needs of the business, throws to the surface significant facts. More — it brings to the man at the head of the business grouped and related details which otherwise would escape attention. A market man in Massachusetts learns from his records of what people are buying, when he ought to push fish instead of meat, or pork instead of mutton. He is getting behind his figures, just as is the manufacturer in Chicago who sets quotas of sales and output based on what has been sold and made in the past and asks "why?" when the monthly reports fluctuate either below or above the figures set. No matter what your business may be, you can set your accounting to watch the significant factors in that business.

Different managers have different methods of finding these significant facts. What some men sense by experience others get from tabulated and charted facts. A factory cost accountant put in a rather elaborate system for the superintendent. He col-

[1] *System*, January, 1913, pp. 3–12. Reprinted by permission of *System*. Illustrations of charts are omitted.

lected the costs of steel for the blade, the wood for the handle, the labor and overhead expenses in making a kitchen knife. After he had collected figures for a couple of months, the superintendent of the plant took a notebook out of his pocket and said that they had agreed pretty closely with what he had figured as the costs on the different grades.

The superintendent knew by long experience the average total cost of certain classes of orders. But when the cost man went over his tabulated figures and showed him the relative department charges for overhead expenses, he brought to the superintendent's attention a fact which he had not before realized — that he was losing money on certain classes of goods. Only by department comparisons could such a condition come to light.

A suitable cost system in a manufacturing plant may show one manager the significant facts in his business. Figures may prophesy in a merchandising establishment, when the records are planned to control the business. The sales manager of a large jewelry house, with an extensive local and country business, has a plan for knowing what is going on, which is adaptable to other lines. Like other executives, he has found that charts showing gross sales both in quantities and money values will enable him to know definitely what the sales department is doing in each line and will direct him to the weak spots in his organization.

Returning from a trip abroad, he found unexpected conditions in the business, as indicated by the chart. A summary of sales by months and accumulative sales for the same period had been contrasted with the corresponding figures for the corresponding month or period of the previous year. At the beginning of January, 1911, just before the general manager left, quite an extensive advertising campaign had been prepared. He had looked for a large increase in sales.

But as the chart indicated, when he returned on the last of May, instead of an increase there had been a gradual decline in business for the current year. Investigation showed that the advertising campaign planned to start the first of January had not been begun until late in March. Had he not compared his sales he would not have learned at once the cause of the decline. As it was, the in-

crease of business which was shown for the months of July and August on the charts was made possible by the prompt application of additional pressure on the sales and advertising departments.

Records of this sort reduced to a unit basis enable the managers of all kinds of businesses to watch their courses. Statements and charts, which show the average price realized per ton, per pound or per barrel by steel, glue, and brewing companies, enable the sales managers of these respective concerns to keep in touch with the results obtained by each salesman. Similarly the payrolls of large retail stores are watched. A record is kept of each clerk's business, day by day. Each week the percentage of salaries to the sales made is calculated. At any time the superintendent and department manager know what the payroll stands for in sales, and which clerks are efficient.

Whenever a business man, at the end of the year or the month, sits at his desk with the figures of the period before him, one of the obvious things he watches is the relation between expenses and the amount of business done. His records must be planned to show comparative statements and charts of sales, cost of sales, expenses and net profits. Unless the figures get to him in this form it is difficult to see how the outlay matches up with the amount of business done.

An interesting example indicates how the vice-president of a wholesale house follows gross profits and departmental expenses by means of a chart. Trade conditions had been poor and one of the department managers failed to compare his departmental expense with his gross profits. This condition continued until the month of August when, as the chart indicated, the gross profits were practically consumed by the departmental expense. Each month now this department head gets his comparative statements of gross profits and departmental expenses and does not wait for the figures to "push" him. He pushes the figures.

Tradition says figures do not lie. Yet, the wrong interpretation of figures may throw the head of the business completely off the track. Groups of facts must be considered with relation to the right groups of corresponding facts. Both sides of the question must be considered in the tabulated statistics.

A sash and door company began to scrutinize the records of its twelve salesmen, mostly young and middle-aged men. The low gross sales of one of the older salesmen at first led the president to believe that this older man was being kept on the payroll for sentimental reasons. But when he took the sales records of the various products and compared them with the profits obtained on each sale he changed his mind. He found that while the older man sold less in the aggregate than his fellow travelers, the total profit on his business was greater. Because of his experience, he knew the profitable and unprofitable lines. The comparison of the two sets of figures showed how the company had gone wrong and a new sales policy was inaugurated at once. Every salesman was instructed to concentrate effort on the profitable lines, and allow the low-profit lines to sell themselves or use them to push the more profitable specialties.

Look into any group of figures for the significant items; the records of one department compared with the others or of one branch compared with the next will often suggest a more uniformly profitable way of handling the business. Lumped figures do not show tendencies. A poor machine in one department may keep up the total relative cost of the output of that department. One slow line of goods may distort the figures of a store. It is better to individualize accounts wherever possible in order that each may stand on its own merits.

The president of a mining company suspected that his repair and renewal account was higher than it should be purely because of his general knowledge of conditions. Not until he had compared the expenditures for repairs and renewals on three machines did he realize that two of the machines had suffered unjustly for the fault of one. The three cutting machines were of the same general design and cost and were installed about the same time. When the facts came out that machine Number 3 had much greater repair and renewal expense than the other two, it was discovered that the man who had charge of this machine subjected it to much rougher usage than the operators of either of the other two machines.

Figures that mean most to the head of a business must contain all the elements entering into a consideration of any particular

item. Statements and charts of sales and expenses only without cost of goods sold may prove misleading. Business is done for profit, not for sales totals.

Often by matching department with department, branch office with branch office, machine with machine, or clerk with clerk, a better understanding can be obtained of what the business is doing. It has been found in many businesses that comparative expense statements, furnished to branch managers with the comments of an executive officer, will do much to hold down cost. On the second Tuesday of each month, the manager of a soda-fountain business devotes his entire day to the study of statements and graphic charts. Sales, branch and departmental expenses and other elements entering into profit and loss accounts come under his supervision. One of the reasons why the company can do business at a low cost is because the manager knows how to use the figures in his business.

Studying a statement itemizing the expenses of one of the larger branches of the company, the head noticed that the wages of the unloading and shipping department increased in the four months ending April 30th over a similar cost for the slack season of the previous year. Investigation developed that the manager of the branch had failed to cut, from eight to six, the men in his receiving department.

Receiving and shipping expenses at the Kansas City branch, greater than the average shipping expenses of the seven or eight other branches, drew attention to another condition which might not have come to the manager's notice. Inquiry showed that the receiving and storage facilities were inadequate, that it was necessary to handle material twice in unloading and storing, that the bins, shelves and general layout were poor. By spending five hundred dollars for the improvement of the storeroom, the company made an annual saving of sixteen hundred dollars in this particular item of expense.

Just as a sales manager may get from his records definite knowledge of his sales and profits, so the manufacturer can devise intelligent summaries of expenses that will show him the relative costs of his products. Overhead expenses often go up mysteri-

ously. Unless the expenses are put on paper in comparative form, it is hard to get behind the totals and find out just what is causing the increase in expense. Non-productive labor, salaries of timekeepers, order and shop clerks and supplies consumed are all details which the head needs to group in such form that ready comparisons may be made.

Itemized, comparative figures make it possible to find the reason for high overhead expenses in the monthly statement of a business. Bulk totals, unless seen in relation to other figures, have little significance unless the man who watches the figures keeps the basic figures in the back of his head, and compares the bulk total with that. Last year's figures may generally be taken as a basis for this year's total. Monthly quotas of expenses sometimes are best. Variations from standard can then be checked before a wrong policy is established. The cost of lubricants in one mine showed a marked increase over the corresponding period of the previous year. When the superintendent investigated he found that the machine operators were burning lubricating oil costing thirty cents a gallon in their torches instead of six-cent illuminating oil.

To check the previous waste, each machine operator was allotted two gallons of oil per day, although an additional quantity could be had by giving reasons. A second cause for the high lubricating cost was caught by watching the amount of money received for oil barrels returned. The credit item for returned barrels seemed smaller than the year before. It developed that the miners, instead of tapping a barrel, had been knocking in the head and filling their pails by dipping into the barrel. About six hundred dollars a year was saved by stopping this practice.

Comparative statements of factory expenses are always instructive. In one case when such figures came to the attention of the manager, an increase of $834.25 in miscellaneous materials and supplies uncovered an important source of waste. The foreman of Department A had in his charge a large stock of materials and supplies, many of which were used in Department B. Unknown to the former, the head of Department B had taken and used wastefully large quantities of material, thinking that the other

foreman would have difficulty in explaining the large debit difference in his material account. Two little columns of figures brought out this badly organized spot in the factory where inefficiency existed because of the jealous rivalry of these two foremen.

All sorts of items in overhead expense can be cared for if the totals come before the manager not in the form of bulk figures but itemized under separate headings. The electric-power-used item in one large manufacturing concern totaled $42,300 for the year ending December 31, 1911. In going over the figures, the manager of the plant thought here was an item which would cost more next year because he expected an increase in the business and power used would increase almost in proportion to an increase in production.

The totals stopped him. They looked big for the work he already did. He went out through the plant and made some rough estimates of apparent wastes in power here and there. Then he talked over the situation with his electrical engineer. He found that by overhauling his wiring, individual meters could be put in the different departments and so the expense of current used in each shop determined. The manager invested nine thousand dollars in these changes. And the first ten months of the current year indicate that in spite of an increase of 15 per cent in production over last year the total power cost will be, roughly, thirty-two thousand dollars. The saving in power alone the first year will pay for the changes made in the power equipment.

Just as properly displayed and grouped figures will show the rise and fall in manufacturing expenses, so they will indicate to the factory superintendent the interrelation between productive and non-productive labor — the totals watched most jealously in every manufacturing plant, since every manager knows the necessity of keeping down the ratio between non-productive and productive labor. The relative importance of these items escaped one manager until he plotted his figures in chart form. Put in this graphic way, the increase in non-productive labor for April, 1911, was apparent at a glance. When the foreman of the department was asked for an explanation it was found that two

skilled workmen had been kept on the payroll during a slack period in order that the men would be available when business increased.

Such records are history. The money had been spent. But it was easy to establish a policy that thereafter the foreman should not settle such questions himself but should confer with the superintendent. In this case it was found that the particular men on this work could have been easily replaced, although in all instances this might not have been the case. In November of the same year, that chart showed that non-productive labor in Department C increased one hundred dollars. In this case, the figures were prophecy, not history, for when the manager went behind them he found that they represented an increase in truckers to carry out a different method of moving and shifting merchandise which was not necessary.

"Let every dollar of capital invested or borrowed perform its full duty," is the way a prominent banker expresses the need of keeping inventories, customers' accounts, notes receivable, cash and working liabilities at the minimum and at the same time producing the maximum earnings. These are conditions which the managers of a variety of concerns may look for in their statements. Just as records will show tendencies in sales and explain department outputs and machine efficiency, so the financial condition of a business may be watched.

Under normal conditions investment in working assets of such businesses as hardware, grocery, paint, shoes, jewelry, drug, dry goods, automobile and steel can easily be determined. Definite relationship must exist between capital represented in working assets and the annual turnover. Records can be drawn from different sections of the business to show "lock-up in working capital" at the close of each month. Failure to keep this at the minimum necessitates borrowing and paying of interest otherwise unnecessary.

One manufacturer traced his uninvested working assets through his record of uncollected customers' accounts and inventories, as shown by his charts. Two branches in St. Louis and Omaha, selling belting, pulleys and other supplies, did substantially

the same volume of business and operated under much the same conditions. The figures showed, however, that the Omaha branch had an investment in stock and accounts $30,000 larger than that of the St. Louis branch. When the situation was sifted down to its elements, it was discovered that the Omaha branch did not give the same strict attention to stock-keeping and the collection of accounts as did the St. Louis office. By installing a perpetual inventory and efficient sales records and revising the collection methods, the Omaha situation was brought up to the St. Louis standard.

In like manner the investment in the several classes of assets in various businesses may be profitably compared. Just as well as in sales and expense, the head of the business may see his figures in a " per unit " form. On this uniform basis, the relative investment in different branches can easily be seen and the working assets kept at the lowest possible points in all.

Nor is it in the large business alone that this class of records is worth while. A printer doing an annual business of about $25,000 revised his storekeeping and accounting system and reduced his inventories by $1,500 and his uncollected customers' accounts by $2,000. This $3,500 has enabled him to pay off bank loans and save about $175 a year in interest. The plan by which he reduced his inventory should be of less interest to every business man than the fact that a basic principle in business is careful watch over the investment in inventories, customers' accounts, and notes receivable.

The inventory figure in any business is a worth-while study, not only from the investment angle, but from that of sales and purchases. Comparisons of sales, purchases, and inventory from time to time will bring out facts in the business and help to maintain their correct ratios. Records that show when to buy will enable the purchaser to keep fresh materials and stocks on hand, as well as reduce capital tied up in inventories.

That definite figures, rightly grouped, will bring before the head of a business a better understanding of his whole business, these various experiences of other managers show. Any business man may take a similar point of view on his figures.

Figures that prophesy mean the success or failure of men in business. For right accounting is more than history. It is not enough to know what has been done; records should show what should be done. The directors of a large Eastern manufacturing concern, with inventories valued at ten million dollars, voted to pay an expert eighteen thousand dollars a year to devise means of giving them figures that would prophesy. By devising and installing a system of purchasing, receiving and storekeeping that would enforce minimum stocks of raw materials, goods in process and finished products without impairing the efficiency of the business, the money tied up in inventories was reduced by nearly two million dollars. The directors proved the value of right accounting.

Any business man who looks upon his accounting as mere recording and not as a method of control for the details of his business misses the vital significance and use of the facts behind its figures.

V. The Load Factor [1]

By G. P. Watkins

The load factor, as defined by electrical engineers, is the ratio of average to maximum load for some specified period. More generally expressed, it is the ratio for a particular good or service of the average demand (in the sense of "demand" as used in economics) through a period of time to the greatest demand at any one time within the period. This concept, as it applies in relation to the commercial supply of electric energy, will be dealt with more in detail below.

It is the purpose of this article to discuss not the load factor as such but rather the extent to which a consideration of the principles involved may disclose ideas that are of general applicability in economics. We owe the term to the electrical engineers. But it is not impossible that economists will prove the better interpreters of an idea that relates so definitely to economic technology.

[1] *American Economic Review*, vol. V, pp. 753–770. Reprinted by permission of *American Economic Review*.

The load-factor concept relates to a very important subject in economics — to no less a subject than the variation of the productivity of material agents. First in respect of both date of discovery and of fundamental importance among the principles governing the variation of productivity is " diminishing returns." Second is the economy of large-scale production, often none too aptly referred to as a principle of " increasing returns." We are not here concerned with the limitations under which these principles operate, but it should be noted that the second is of less general significance than the first. The " load factor " refers to a third important phase of the variation of productivity, distinct from each of the others, though perhaps not so general in scope. In brief, cost per unit of product varies according to: (1) the difficulty of obtaining the services of relatively scarce agents of production; (2) the magnitude of the commercially practicable scale of production; and (3) the degree to which the conditions of economic demand, apart from maladjustment of the supply of productive capacity, permit the full utilization of such capacity. It is with the third phase of the variation of productivity and cost that this article deals.

The terms ordinarily employed to designate the first two of these factors are open to objection, being insufficiently definite in meaning and not lending themselves to generalization. " Diminishing returns " and " increasing returns " are not actually, as the words suggest, the opposites of each other, for in the one case the reference is to a given area of land (or quantity of other productive agent) and in the other to the unit of business enterprise. Farms, as cultivated more or less intensively, may at the same time exhibit both diminishing returns and increasing returns; that is, the return per laborer or per $1,000 of capital employed upon the land may be relatively smaller on the more intensively cultivated farms than on those under less intensive cultivation, but managers may find more scope for organization and directive ability in the former case so that their net returns are greater than in the latter case. The combined return will exhibit the more or less balanced result of the action of both factors. The commercial value of services and products has no necessary con-

nection with the phenomena in question, though it happens to be convenient to measure quantity of capital in terms of dollars.[1]

The applicability of the principle of diminishing returns, moreover, has been restricted to agricultural land by the classical economists in ways that are of practical significance as well as of great historic interest. Such restrictions, even if not entirely logical, inevitably make the term less suitable for the general concept.

I have therefore sought other names for the two familiar factors in the variation of productivity, and will in general refer to the first as the proportionality[2] factor; to the second as the density factor. A third, of course, is the load factor. There is an evident advantage in having the form of all three terms thus parallel.

The development of the idea of diminishing returns, as resulting from relative scarcity of land, into a general principle exemplified wherever there is deficiency in the supply of any of the means of production, or lack of proportion between complementary agents, has come about quite recently. If we may call the more general conception the proportionality factor, "diminishing returns" properly retains its time-honored reference to land, though hardly to merely agricultural uses of land. Its phenomena are, of course, only a species of the effects of the proportionality factor. But the most important species may well have its distinctive name.

The concepts here dealt with all relate to economic technology and therefore the terms used should not suggest a different sort of thing. It might seem appropriate to call the second the concen-

[1] Commons, for instance, in his *Distribution of Wealth* (1893), pp. 158–159, is inclined to extend the principle of diminishing returns to the highest degree of generality by measuring return in pecuniary instead of physical units. This in effect confounds diminishing returns with diminishing utility and deprives the former of its distinctive content. See also the following footnote.

[2] *Cf.* Carver, *Distribution of Wealth* (1904), p. 65, where "proportions" is used in this way. Wicksteed, *Common Sense of Political Economy* (1910), bk. II, ch. 5, acutely criticizes the older ideas of increasing and diminishing returns and gives some effective illustrations of the latter as a matter of proportionality. But his statement that the latter is a "sterile proposition" is ill-considered, and he is too ready to accept pecuniary measures of the quantities whose variation is in question as sufficient. Davenport, in *Economics of Enterprise* (1913), ch. 23, discusses the "law of proportions" as a technological as well as a pecuniary matter, though he over-emphasizes interpretation in terms of price.

tration factor, but for the fact that this could easily be taken to refer to the financial control and direction of industry rather than to technological aspects. It is true that the large-scale manufacturing plant requires the concentration in one spot of the means of supplying a large area or an extensive market. The tendency is not ordinarily apprehended as causing density in the geographical distribution of the processes of manufacture, but, once pointed out, the fact is evident. "Concentration," moreover, does not suggest what happens when the development in population and industry of a railroad's territory gives it more traffic and larger profits. Hence "density factor" seems to be the term most generally applicable and least likely to be misunderstood in referring to the second principle. "Large-scale production" in its narrower sense is not intrinsically objectionable — though density rather than volume of transactions is what is really important — but the phrase has not the desired parallelism with its congeners and it also has been applied to describe "combination" or concentration of control, which is a different matter and an affair of commercial policy rather than of economic technology.[1]

In one important particular the scale factor is different from what we may call the density factor in the narrower sense. The scale on which an ordinary manufacturing plant is constructed can be voluntarily determined with reference to the existing or immediately prospective degree of condensation of demand or to the "extent of the market." In the case of services rendered in a particular locality, on the other hand, the capacity of the plant will most likely be determined chiefly by technological considerations, and its full utilization will wait upon the growth of demand, which in turn is dependent chiefly upon growth of population. Therefore the density adjustment is in this case largely passive. When there is a material product susceptible of transportation, furthermore, the process of condensing the demand from larger and larger areas facilitates the deliberate exploitation of density-factor economies in a way that is not open to the "service" indus-

[1] Bullock's term for the effects of the density factor is "the law of economy in organization" ("The Variation of Productive Forces," *Quarterly Journal of Economics*, vol. XVI, 1901–1902, p. 472).

tries. But a distinction between the density factor and the scale factor along this line would be chiefly a matter of emphasis. They are, at any rate, species of the same genus, or varieties of the same species.

Designation of Principle	Condition to which it Relates	How Dealt with Practically
Proportionality factor Diminishing returns	Degree to which relative quantities of various economic agents used in conjunction with one another are strained, especially with reference to the crowding of specific quantities of the most costly ones.	Tendency to increase in unit cost held in check or reduced by substitutes and by straining the proportion in which agents are best combined.
Density factor Extent of the market Increasing returns Large-scale production Economy of organization	Degree to which the quantity of the product demanded at a given place admits of or promotes the most economical organization and scale of operations.	The advantages of lower unit cost are gained by transporting the product greater distances or they develop automatically with increasing density of population or increasing general purchasing power. Price differentiation is to some extent used to promote sales.
Load factor	Degree to which conditions of demand and the cost of keeping products permit continuous operation of plant and of individual machines, etc.	Invention and application of means of storage. Diversity of uses develops along with density to a considerable extent automatically, but especially price-differentiation is deliberately employed to smooth out and promote the continuity of demand. Educating the consumer to greater regularity in purchasing counts for something.

Whether it is desirable to make a distinction between the density factor and the scale factor is important in this connection only in relation to the use of the former term in the more general sense. Mass is the product of density times volume, density

being a ratio. But "place" must be taken in a liberal sense in economics, according to which sense scale (or mass) and density become practically synonymous. With reference to the density factor, condensation relates not to a given area, still less to a given number of cubic feet, but to a "place" that may include any convenient number of contiguous or associated acres, the limits of the place being determined merely by the possible extent of one management.

The relation between the three factors is summarized in the tabular statement above.

The Load Factor in Relation to the Supply of Electric Energy

The term "load factor" was invented and its use has developed in connection with electrical supply. The load factor is always, either explicitly or by implication, a determining consideration in electrical rate making. The term has been rather loosely used. The authoritative definition of the Standards Committee of the American Institute of Electrical Engineers adopted by the Institute is: "The load factor of a machine, plant, or system is the ratio of the average power to the maximum power during a certain period of time." It should be noted that the reference is to economic determinants, that is, to conditions governing the variation of demand, without more relation to generating capacity than is involved in the assumption that it is sufficient to meet the maximum requirement.

The connection between the load factor of a central station and the kilowatt-hour burden of the charge for fixed capital is evident. The load-factor ratio may be stated as a ratio (per cent) or as a certain number of hours' use of the maximum demand. In something like this latter form, that is, as average hours' use per day of connected installation, it is frequently explicit in electrical rate schedules. But the consumer's connected load, or some defined fraction of it, is usually, in this application, the makeshift representative of the second term of the load-factor ratio. It is obvious that a company with consumers using twice as many kilowatt-hours as the consumers of another company having the same system maximum will require but half the generating capac-

ity of the latter per kilowatt-hour distributed and will thus be free from a heavy burden of fixed charges, to mention only one element in the consequent saving.

To illustrate the range of variation of the load during 24 hours, we may cite figures for the New York Edison system in Manhattan and The Bronx. Because of the density and diversity of the consumption of electricity in this territory, the range of variation is less than for but few favorably situated companies. The data of hourly output for clock hours as averaged for four December, 1913, work days excluding Saturday, this being the period of heaviest demand, show a maximum hourly output of 183 per cent of the average and a minimum of 34 per cent, the range of variation being thus 149 points per cent. The diurnal load factor of nearly 55 per cent (100/183) is, of course, exceptionally good. The annual load factor of the system in 1913 was about 34 per cent.[1]

It is for the best interest of an electrical company so to adjust its rates that consumers at off-peak times — that is at times when the load is light or at any rate less than the maximum — will obtain some benefit from the comparatively low cost per kilowatt-hour of energy supplied to them. If one consumer uses electricity for a single hour a day and another for five hours, and if their kilowatt demand or utilized connected load is the same, the burden to the company on account of the fixed investment is five times as great per kilowatt-hour for the first as for the second consumer.

The above paragraph contains a hint of a necessary qualification. If the 5-hour consumer takes his current steadily from 12 noon to 5 P.M. and the 1-hour consumer from 5 to 6 P.M., the company is benefited rather than otherwise by the nature of the demand of the short-hour user. If the needs of the long-hour consumer were of decisive importance in causing the investment to be made, then the sixth-hour consumer, causing no additional investment, might be said not to impose any additional cost on account of capital charges. The load factor of an individual con-

[1] Vol. III of the *Annual Report of the New York Public Service Commission of the First District for 1913*, p. 54. The data for the preceding comparisons are shown on pp. 60–61 and, in more available shape, in Diagram II.

sumer does not sufficiently determine the fixed cost he imposes unless his maximum load or the peak of his demand comes at the same time as does the system peak.

The diversity factor takes account of the difference in time between the peak of the demand of a consumer or class of consumers and that of the central station. It is defined by the Standards Committee of the American Institute of Electrical Engineers as " the ratio of the sum of the maximum demands of the subdivisions of any system or part of the system to the maximum demand of the whole system or part of the system under consideration, measured at the point of supply " (that is, at the common point). The importance of diversity to the theory of rates is evident from the illustration above given.

It is, of course, the peculiar nature of the commercial supply of electric energy that has led to the development and use of load-factor concepts here rather than elsewhere. The fundamental peculiarity is the economic impossibility of providing electric energy ahead of demand and storing it at will until the consumer wishes to use it. Most goods can be stored, though at more or less cost. Electric energy for ordinary use cannot be economically stored to any considerable extent. Hence the problem of the electrical enterprise is so to develop and train economic demand that it will largely adjust itself to the conditions of supply instead of, by its arbitrariness, increase costs in a way that must ultimately react to the disadvantage of the consumer. The unit cost of interest and depreciation is not correctly calculated when simply prorated over the kilowatt-hours taken.

Another element in the situation which favors the development of load-factor concepts in the electrical industry rather than elsewhere is the very large portion of total unit-cost that is made up of carrying charges for fixed investment, that is, of interest and depreciation. In respect of the dominant importance of capital (in the large sense, including land) as compared with labor employed, railroads probably rank higher than any important branch of manufactures. But this ratio is almost as large in the electrical industry as it is for railroads. For hydro-electric plants it is doubtless often much larger.

The central-station electrical industry, furthermore, is conspicuous for a very high rate of depreciation, especially so if this term is used to cover obsolescence. Hence fixed costs per unit of product, which cannot be neglected with impunity in any industry, are of greater importance in the electrical branch than anywhere else.

Why, it might be asked, have load-factor concepts developed in connection with the electrical industry rather than with the railroads? In both cases we find highly developed systems of differential rates that seek to distribute the burden of fixed charges unevenly in a way the public is prone to think unjust. The dominant importance of fixed capital is the fundamental factor in both cases. But the policies at the foundation of the classification of freight cannot be reduced to quasi-mathematical rules. The elasticity of the demand for carriage is not an engineering but an economic fact. There is no difference in physical cost for the carriage of different kinds of freight of given weight and bulk for equal distances. Differential rates have been developed in order the more fully to utilize the railroad plant. But the policy has little reference to time, and is certainly not primarily intended to provide work at slack times. The time adjustment may, if necessary, be effected by delay in transmission. The economic nature of the problem appears to be generically the same for the railroad and for the electrical company in the sense that both are striving fully to utilize an existing plant, but in the one case the time of demand is of little importance while in the other it is all-important. Of course the elasticity of the demand of a particular class of users of electric current will not fail to be considered by an electrical company in determining to whom low rates shall be offered, but this element of the situation is generally quite overshadowed by regard for load and diversity factors.

In order to improve its load factor, an electrical company will offer low rates for uses that normally require off-peak service, especially if such uses are new and developing. Beginning with street lighting, the electrical-supply business has gradually extended to commercial lighting, domestic lighting, industrial and other motor or power uses (such as elevator service), storage

battery service for automobiles, various domestic appliances, and, finally, refrigeration. The last-mentioned is perhaps the prospective field of large importance next to be occupied. Electric heating on a sound economical basis seems to be a thing of the more remote future. Most of the applications mentioned, especially the later ones, have been favored with special attention and low rates by electrical companies.

An economic interest in load factors need not take us further into details. It is the purpose of this paper to deal with the generalizability of such concepts, not with their application to a particular industry or community.

It is worth while to mention in this connection the "capacity factor." This may be defined as the ratio of the average output of a given period, usually a year, to the theoretical potential output, supposing continuous use of rated capacity. This is not of peculiar importance to the electrical industry. Nor is it of theoretical interest for the study of load factors. The idea, however, serves to correct a possible mistaken inference from these ratios as ordinarily computed. No electrical plant could run at full capacity for every hour in the year. When there is no available reserve capacity, the realized capacity factor is the same as the load factor. The greatest physically practicable capacity factor marks the limit of possible utilization — supposing load and diversity factors so ideal that operation can be continuous so far as thus controlled by economic conditions — under existing conditions of engineering technique. The capacity factor has often been confused with the load factor. Sometimes capacity factors may be used to advantage for statistical purposes where load factors cannot be ascertained.

Public Service other than Electrical Supply

The applicability of the load-factor concept to a given enterprise or kind of business depends upon two conditions.

First, there must be heavy investment in fixed capital. It is unnecessary to prove or illustrate the fact that modern industry is highly "capitalistic," in this sense of a word used also in other senses, and that it tends to become rapidly more so.

The second requirement is that the product be of such a nature that the time and the place of use cannot be varied at will to suit the notions of the consumer. Any adjustment there may be must be made in advance, and if the consumer does not conform his choices to expectations, the product or service offered fails of its economic purpose. It must be used "on the spot" or immediately where and when it is made available for consumption. "Where" and "when" are, of course, to be taken in an economic and elastic, rather than a metaphysical, sense.

The enterprises of any industry that meet these two conditions have load factors, and their unit costs vary according to whether the load factor is good or bad.

In a general way it is the "public service" enterprises which fulfill the above requirements in the highest degree. The word "service" here may be taken to have substantially its usual economic sense. It is especially because the consumer cannot exercise an effective option as to where and when and by whom he shall be served that such enterprises are always more or less monopolistic. The central-station electrical industry, from which the term load factor comes, is one such. All transportation agencies — steam railroads, street railroads, the merchant marine — belong in this class. The service of merchant ships is peculiar in so far as the supply may be adjusted to the variations of demand throughout all portions of the globe that are accessible to water transportation. In this case the "when" of the service is most important and the "where" rather incidental. Gas and (urban) water supply — though in these cases material commodities are placed in the hands of the consumer instead of the supply being strictly a service — constitute another class of public service enterprises. They are peculiar in that the gas and water may be stored. There is thus some emancipation from the time restriction on consumption. The telephone and telegraph are definitely and unqualifiedly of the "service" class.

It is often assumed that there is something about the political nature of public service corporations that constitutes them a class by themselves. But the fundamental reasons why they are quasi-public or "affected with a public interest" are economic. Their

monopolistic power (which, however, does not hold of the merchant marine) is due to the large amount of fixed capital they require and to the impossibility of making the services of a particular enterprise available except in its own restricted area. Hence the need of public control to take the place, in part, of competition as a regulator of prices and of the quality of service. The fact, also, that the consumer, especially the small consumer, has practically no choice, but must be served by the one corporation or go without, makes him unable to protect himself against discrimination and unfair treatment.

On the side of the company, the density factor and the load factor give the railroad or other public service corporation special incentives to differentiate and discriminate in their charges. Hence it is necessary to regulate the public service corporation with reference to the method as well as to the total amount of its charges.

The supply of water to a city might be expected to be a particularly significant illustration of the way the load factor works, because the commodity apparently costs nothing itself, aside from carrying charges for fixed capital in reservoirs and pipes and similarly invariable expenses. The physical commodity is to be had in unlimited quantity. Pumping, however, is usually required and this is a variable cost. But it is a small factor. A city's water works are generally owned by the municipality. Therefore the prices charged may or may not conform to load-factor principles or to any other principles, because the amount collected may be, as it is often called, a "tax" rather than a price. The problem of adjusting rate of supply to rate of demand in this case is seasonal and due not so much to the variation of demand as to that of supply. There is likely to be tremendous expenditure for storage accompanied by little or no attempt to regulate demand, not even to the extent of preventing waste. But the reserve supply has also largely an insurance function. And no adjustment of water rates should restrict the use of water for sanitary purposes.

The peculiarity of the relation of the water supply to demand will become more important as water comes to be extensively

impounded to be used for power. In connection with long distance transmission by electricity, such a development suggests hydro-electric plants on a great scale. For such plants it is recognized that the load factor is even more important than in central-station service.

In telegraphic service the night-letter (off-peak) business at specially low rates is an interesting application of load-factor considerations. Off-peak ocean cable rates are also being tried. These policies are adopted with the express purpose of lowering cost by improving the load factor. Emphasis upon such matters, if not attention to them, is a matter of recent years.

The telephone has been recognized as peculiar among public service enterprises, because the density factor that increases the proportion of profits as business increases does not seem to operate here as certainly as in other cases. But this is owing to the rather unessential circumstance that the subscriber was originally taken as the unit of service instead of the call. The present tendency is towards measured in place of unlimited service, at least in large cities, where the rate per subscriber is in effect merely a guaranteed return. The pressure of the daily telephone peak in cities is of great importance, since an overload can be taken care of only by developing human capacity, or by delay. Commercial methods of depressing the peak have not been developed.

The relation of the load factor to the steam-railroad rate schedule is rather incidental than of fundamental importance because the density factor is here of more decisive influence than the other. Carrying charges for fixed capital which it is desired to utilize more fully are still the controlling element in the situation. The result of both factors is differential rates, but of two different types. In steam-railroad practice the principal aim is to increase business and the dominant consideration is regard for what the traffic will or will not bear. An electrical enterprise is also interested in increasing the load but is, or should be, much more interested in equalizing it. A railroad may double its freight without any appreciable addition to its investment except for rolling stock, and the required increase for that, owing to the oppor-

tunities of the back haul and of partly filled cars, may be much less than 100 per cent. An electrical company must double its generator capacity to provide for such additional demand, unless it improves its load factor. Its investment for transmission and distribution is less likely to be much affected, thus resembling the track and roadway of a railroad.

But the load factor does somewhat affect the rate policy of railroads. Excursion rates at particular seasons are explicable by reference to it. Differences in respect of the load factor also are doubtless one reason for a higher charge for passenger service than for non-perishable freight. The seasonal variation of the amount of traffic [1] is one consideration in freight classification, but this is no doubt governed in the main by regard for the density factor. The economy of fully loaded cars and of longer freight trains, which has been much emphasized of late, is an affair of the load factor. The diurnal variation of one sort of passenger demand is important for steam roads terminating in large urban centers with considerable commuting population. Passenger stations may have to be specially adapted to the volume and character of commuter traffic.

In street railway service there are some peculiarities from which the usual 5-cent flat rate may distract attention. The problem of the daily traffic peaks or "rush hours" is familiar.[2] The over-loading of street cars to meet the peak is less restrained by physi-

[1] *Cf.* Ripley, *Railroads; Rates and Regulation*, p. 100, for an illustration of the importance of this factor as indicated by the variation of gross and net revenues from month to month.

[2] It is of interest to note that John Hopkinson — to whom more than to any other individual the appreciation by electrical men of the importance of the load factor is due — in his pioneer discussion uses a railway illustration to make clear his meaning, as follows: "For example, the Metropolitan District Railway must be prepared to bring in its thousands of passengers to the City at the beginning of the day and to take them back in the evening, and for the rest of the day it must be content to be comparatively idle. In this case the services cannot be stored. The line must be of a carrying capacity equal to the greatest demand, and if this be great for a very short time the total return for the day must be small in comparison with the expense of rendering the service. In such a case it would not be inappropriate to charge more for carrying a person in the busy time than in the slack time, for it really costs more to carry him." See his paper "On the Cost of Electric Supply" in *Original Papers*, vol. I, p. 256.

cal conditions than in the case of electrical machines. While the careless overloading of a generator harms the property of the corporation, the rush-hour street railway overload merely causes discomfort to the passengers. Hence the perennial plaint of the strap-hanger. In fact, the street railway cannot economically give the same grade of service at the rush-hour as at other times. The attempt to do so would greatly increase unit costs for such passengers. The street railway has to do also with some specifically electrical peak problems, but they are comparatively unimportant and of engineering more than of economic interest.

Investors are sometimes misled by observing the conspicuous density of traffic under peak conditions into providing large amounts of capital with regard to such conditions rather than with regard to average demand. The great seasonal demand for transportation from New York to Coney Island, for example, doubtless caused the too rapid supplying of facilities for this traffic some thirty years ago.

Any measure that will effect a smoothing of the transit load has great economic advantages. Whether hours of employment of different sorts of labor could be adjusted with reference to this situation is an interesting question. The facetious classification of morning commuter traffic as consisting successively of " works, clerks, and shirks " has an element of interest in this connection. The adjustment of railway rates with a view to effecting a reduction of the peak — daily, weekly, or seasonal — would doubtless encounter a good deal of prejudice, though higher Sunday rates are not unknown.

The collection, transportation, and delivery of mail constitutes a service in which the load factor is of great significance. Here the labor element is a more important consideration than the fixed capital directly involved. But promptness of service is of first importance. Hence the problem of the Christmas peak. One reason for the establishment of the parcels post was doubtless the desire to use more fully an expensive organization, but with reference to the density factor rather than the load factor. Whether the present classification of postal rates, with distance disregarded except for parcel service, is economically sound is perhaps ques-

tionable. It is merely a historical product and not well thought out.[1] The extension of the parcels classification to books, however, remedied one conspicuous anomaly.

Other Business Enterprises

The principle once grasped, it is seen that the load factor is significant throughout modern industry, though it does not attract attention to itself by a peculiar system of rates or prices except in electrical supply.

There are some industries in which continuous operation throughout the 24 hours of the day and the 7 days of the week is practiced. However, this involves the employment of two or three shifts or sets of laborers and night work, both of which conditions count against such a continuous use of fixed capital. Hence where 24-hour work is the rule, some other consideration than economical use of capital dominates the situation. It is, for example, only an incidental and minor advantage of the running of blast furnaces 24 hours a day that by such continuous use there is some small saving of interest cost. The ordinary manufacturing plant, a cotton factory, for example, resorts to night work only when there is pressure of unusual demand.

In the case of the ordinary factory, the problem of the full utilization of capital is a question of what to do in slack times, especially slack seasons. The retention of a trained labor force through the dull season is often an important consideration. Manufacturing "for stock" is of course the ordinary recourse, but the determination of how far this process shall be carried, or of what selling and other devices may be adopted to prevent the accumulation of too large a stock, comes up, and is indeed substantially the same old load-factor problem in its seasonal aspect. If the product of the factory is not a standard article but is subject to the caprice of fashion, it does not pay to manufacture much ahead of actual orders. Thus throughout the field of manufacturing, although continuous utilization through the hours of the day is seldom to be considered, the seasonal load factor is important.

[1] The report of the Commission on Second Class Mail Matter (transmitted to Congress February 22, 1912) shows this among other things.

It happens that New Jersey's Bureau of Statistics of Labor and Industries gathers and publishes some statistics indicative of load-factor conditions in various branches of manufacture. The ratios are really capacity factors, but they illustrate the point under discussion. In the 1910 figures, which are the ones at hand, the average figure for all industries was 74.92 per cent and for twenty-five specified industries 74.00 per cent.[1] The minimum ratio was 64.42 per cent, for structural steel and iron, and the maximum 88.12 per cent, for paper. These figures are doubtless based upon the use of the plant by a single set of workmen, without alternating shifts, and for the usual number of working days in the year, such use being rated 100 per cent.

The Massachusetts Bureau of Statistics publishes similar data for "days in operation."[2] The following is quoted from the report for 1910:—

In 1910, exclusive of Sundays and holidays, there were 305 working days, and all of the important industries reported short time to a greater or less extent for the year. Establishments in the boot and shoe industry, exclusive of cut stock and findings, were operated on an average of 283 days; cotton goods, including cotton small wares, 280 days; foundry and machine shop products, 296 days; leather, tanned, curried, and finished, 282 days; paper and wood pulp, 274 days; and woolen, worsted, and felt goods, and wool hats, 271 days. Establishments manufacturing electrical machinery, apparatus, and supplies, were operated 297 days, and jewelry establishments about 287 days. In some of the smaller industries, such as malt liquors, show cases, and musical instruments and materials, not specified, we find practically continuous employment. On the other hand, in brick and tile, a seasonal industry, the establishments were operated only about half time, or 153 days on an average. Lumber and timber products show an average of 247 days.

Reduced to terms of per cent these figures, in order, are as follows: 92.8, 91.8, 97.0, 92.5, 89.8, 88.9, 97.4, 94.1, 50.2, 81.0. These ratios are, of course, not directly comparable with a central-station load factor.

It has already been intimated that these are strictly a species of capacity factor, rather than load-factor figures, and that the conception of continuous operation underlying them needs to be

[1] P. 31 of the annual report for 1911. The ratio is termed the "proportion of business done."

[2] *Twenty-fifth Annual Report on Statistics of Manufactures*, p. xxvii.

made explicit. Doubtless a large proportion of manufacturing establishments have some reserve capacity to provide for future growth. The only suggestion the figures themselves contain as to what allowance should be made for this is that possibly the largest average ratio for an industry would fall short of 100 per cent only by the average amount of the reserve in question, and that this reserve ratio would vary only slightly as between the averages of the different industries. But the strict annual load factor would take no account of fluctuations of demand due to "trade cycles" covering several years, though this rather than the seasonal variation may be of most importance in causing an uneven and usually short load for efficient manufacturing plants.

Though not so named, the diversity factor is very commonly of recognized importance in ordinary business, and its importance presupposes the importance of the load factor. One advantage of the department store over the specialty "shop" is that it can shift the disposition of space and clerical force according to the season's needs, thus improving its annual load factor. The profitableness of commercial banking is entirely dependent upon the diversity of the demands of depositors for funds. A reserve of $100,000 will under most circumstances easily meet aggregate possible demands five times as great.

The variation of demand may be weekly, but if this is a matter of a Saturday afternoon and Sunday discontinuation of operations, that is no more thought of than shutting down over night. If the variation is the reverse of this, so that there is a marked Sunday peak, then the effect is likely to be noticed in a stiffening or increase of prices. Reasoning rather short sightedly, the public is likely to think that any such increase in unit prices at the period of largest demand is extortionate. We cannot be sure that under these circumstances the commercial motive will not lead to attempting to make too much of the opportunity, but there is also the other side of the matter, namely, the question as to what can be done with the investment and the time of those engaged during the unprovided for five or six-sevenths of the week. Such sixth or seventh-day enterprises, however, are often merely auxiliary occupations and even the undertakings of children. The holiday

sale of drinks, fruit, and confections in suburban "park" resorts is the most conspicuous instance of this sort of thing. But this graduates into restaurant and hotel-keeping for similarly variable weekly and seasonal demands.

Not long ago a certain London hotel advertised the quality of its service as being the best obtainable because its good load factor so reduced its average costs. Whether this is as good advertising as it is good economics may be doubted. It certainly is true that the price for a hotel supplying the needs of transients cannot be other than high according to a close comparison of the actual with the theoretically possible use of the investment. Hence Swiss mountain hotels and Jersey coast resorts, once thought of merely as places to go in summer, are now trying to develop winter trade and thus to utilize what would otherwise be idle plant. Some nondescript statistics that happen to be at hand for Swiss hotels in 1906 show monthly capacity load factors (beds used to beds available per night) of 76 per cent for August as compared with 14 per cent for December. The Adirondack hotels also are now seeking winter guests. If we may believe the advertisers, "all-the-year-round" resorts are coming to be the usual kind.

In view of the inevitably low degree of utilization possible, what vanity is it that makes the traveler seek luxuries in hotel accommodations that he cannot afford at home? Decorations and appliances that will be idle 250 days in the year must require triple or quadruple recompense for the 100 days of use. The American weakness for having "the best of everything," always traveling "first class" and going to the "best hotels," imposes a tax that only a very prosperous people could stand.

It is because of the load factor that one can get a better lunch at a restaurant which is also a saloon than at one which meets the demand for light noonday meals chiefly and for occasional evening dinners or suppers, and whose plant is otherwise unutilized for most of the 24 hours.

Since the variation of the seasons is the fundamental condition of plant growth, one would expect load factors to be especially important in agriculture. In this case it is the "industrial"

demand for uses of means of production that varies, not the demand of consumers for final products. Fixed capital used in agriculture has a poor load factor because the seasons restrict the use of any kind of agricultural machinery to a particular portion of the year. This holds even where one farmer does the reaping and binding for several neighbors. Threshing and hay pressing are less restricted, the former lasting all the autumn, the latter possibly also through the winter. Probably the chief reason why agriculture is carried on to so great an extent with poverty of appliances is because the load factor for capital used is so unfavorable. Farming cannot economically be capitalistic, in one sense of the word, to the same degree as the manufacture of cloth, for example. A seeder that is passed around among neighbors and used by some of them at not just the right time is, even then, of use only during the good days of a single month or six weeks in the year.

In certain kinds of demand there is no recurrence of need. Under such circumstances it is impossible to compute a load factor, because that supposes a period of use and a permanent investment. But the economic interest in this case is of the same nature as in the case of a recurrent peak. The price paid for the use of a grand stand to view a parade must be very large in proportion to the investment. Pageants and spectacles are similarly costly. Hotel accommodations for large crowds at expositions and political conventions should not be expected "at regular rates." Monopolistic exploitation of such conjunctures, unfortunately, is much more likely. But, in the case of specially provided accommodations, there should be some allowance of extra return (in case the enterprise is successful) on account of economic risk.

The attempt to get a high price for a brief seasonal or temporary use of capital often leads to angry protests against so taxing the peak. The summer demand for extra ice and for bathing accommodations affords familiar examples. Public opinion may easily expect too much of dealers in hot-weather necessaries. Holiday travel is sometimes similarly taxed. In all these matters the responsible managers of business enterprises occasionally

forget that, even if the public is somewhat prejudiced — and dealers are not the best judges on this point — what is bad business policy cannot in the long run be good practical economics.

VI. Statistical Reports of the Utah Consolidated Mining Company[1]

By W. H. Charlton

In the Bingham Mining District of Utah, the ore bodies are found as irregular replacements in limestone.

The ores of the district contain values in copper, gold, silver, lead, and zinc.

At the present time the commercial activity of the camp is centered on the copper-iron sulphide ores mainly, with lead-silver sulphides receiving second consideration.

The Highland Boy mine of the company is opened with five tunnels, driven into the mountain at as many levels, along the strike of the out-crop. These tunnels are connected by both vertical and inclined shafts, equipped with ladderways and ore chutes, to facilitate underground operations.

Drifts and cross-cuts are run into the ore bodies at convenient places from the different tunnels. The ore is broken down in the stopes with the aid of machine drills actuated by steam power. The ore is then chuted down to the lowest tunnel level and loaded into tramcars to be run out to the head-house in trains of ten cars each, where it is loaded into the buckets of an aërial train for transportation about two miles down the canyon to the railroad, to be shipped to the smelter for treatment.

The Utah Consolidated Mining Company uses the graphic system of recording data. This graphic method soon indicates the point that must be specially investigated and as a consequence the use of graphic methods has been attended by a steady increase in the amount of detailed information gathered.

While the system is quite comprehensive and takes in many ramifications of the work, as will be seen when the details are

[1] W. H. Charlton, *American Mine Accounting*, pp. 149–167. Reprinted by permission of McGraw-Hill Book Company. Illustrations of forms are omitted.

given, still the introduction has been so timed that the men gradually accustomed themselves to the system and the extensions have been so logical that no trouble has arisen. Besides, while the work as will be seen covers much detail, the gathering of the detailed information and the methods of recording it in tables have been so simplified that the plotting and tabulating is done by two men who keep up the details of the geology in the stopes as well as planning and looking after all development work and inspecting the principal stopes each day for changes in geology. In a mine consisting of a series of irregular ore shoots in a fractured and dislocated country the amount of geological work is necessarily quite large.

Of course this matter of keeping track of details can be carried to an extreme, and might possibly become more of a detriment than an aid, were it not that the graphic method soon indicated the important points to watch in each operation and what details may well be omitted as the system is extended.

In order to keep the graphic records it is necessary for several men to collect the data that is used in preparing them. To render this easier and to simplify the work as well as to have the records uniform, practically everything is recorded on printed forms.

Exploring. This account is intended to cover all cost including labor and supplies incident to exploring new ground.

Development. This account is intended to cover all cost including labor and supplies incident to the development of known ore bodies.

Shafts and Tunnels. This account is intended to cover all cost including labor and supplies in the sinking of new shafts and the driving of new drifts.

Stoping. This account is intended to cover the total cost including labor and supplies of breaking ore in stopes.

Tramming. This account is intended to cover all cost including labor, supplies and power for tramming by hand and by power.

Hoisting. This account is intended to cover all cost including labor, supplies and power to operate and maintain both engine houses, hoists, pulley stands, etc.

Pumping. This account is intended to cover all cost including labor, supplies and power to operate and maintain all pumps and water lines underground.

Timbering. This account is intended to cover all cost of handling, framing and placing in the mine all timber used underground. It does not include the cost of the timber used.

MINE LEDGERS — OPERATING ACCOUNTS

Expense Accounts	Distributed Accounts	
	Closed Accounts	Shop Accounts
Exploring	Boilers	Machine Shop
Development	Compressor	Blacksmith Shop
Shafts and Tunnels	Electric Lights	Carpenter Shop
Stoping	Heating	
Tramming	Fuel	
Hoisting	Explosives	
Pumping	Lumber and Timber	
Timbering	Teaming Timber	
Cars and Tracks	Supplies	
Operating Tramway	Surface Waste	
New Tramway	General Office	
Machinery		
Laboratory and Eng. Dept.		
Surface Expense		
Buildings and Fixtures		
General Expense		

Cars and Tracks. This account is intended to cover the cost and installation of new cars and permanent track, but does not include the cost of replacing old cars with new ones.

Operating Tramway. This account is intended to cover all cost including labor and supplies of operating and maintaining the tramway.

New Tramway. This account is intended to cover all cost including labor and supplies of building new tramways and trestles, but not repairs to old ones.

Machinery. This account is intended to cover all cost including labor and supplies to cover the purchase and installation of new machinery.

Laboratory and Engineering Department. This account is intended to cover all cost including labor and supplies for running the laboratory and doing all engineering work.

Surface Expense. This account is intended to cover all cost including labor and supplies of odd jobs about the property that cannot legitimately be charged to other operating accounts.

Buildings and Fixtures. This account is intended to cover all cost of new buildings and fixtures, but does not include the upkeep of old buildings.

General Expense. This account is intended to cover all cost of odd jobs underground.

Boilers. This account is intended to cover the cost of operating and maintaining the boiler plant. It is closed out each month to the various accounts benefited on a basis of horse power used.

Compressor. This account is intended to cover the cost of operating and maintaining the compressor plant. It is closed out each month to the various accounts benefited on a basis of quantity of air used.

Electric Lights. This account is intended to cover the cost of operating and maintaining the electric generating plant. It is closed out to the various accounts benefited on a basis of current used.

Heating. This account is intended to cover all cost of operating and maintaining the heating plant. It is closed out each month to the various accounts benefited.

Fuel. This account is intended to cover all cost of coal including freight and unloading charges. It is closed out to the accounts benefited on a basis of tons used.

Explosives. This account is intended to cover the cost of explosives and is closed out each month on a basis of power used.

Lumber and Timber. This account is intended to cover the cost of lumber and timber, also wedges and mine ladders used. It is closed out each month to the various accounts benefited according to the cost of supplies used.

Teaming Timber. This account is intended to cover the cost of teaming timber to the mine shafts. Labor charges only. It is closed out each month to the various accounts benefited on a basis of supplies used.

Supplies. This account is intended to cover the cost of supplies used not otherwise provided for and is closed out each month to the various accounts benefited according to the cost of supplies used.

Surface Waste. This account is intended to cover all cost of filling stopes from surface waste. The whole account is closed into Stoping.

General Office. This account is intended to cover all cost and expense covering the office and superintendence.

All these accounts are further itemized; for instance, the Stoping account is subdivided as follows: Labor, Supplies, 3–B Rand parts, 2¼ inches, Rand parts, 2¼ inches, Sullivan parts, 0–D Rand parts, total of all the above supplies. All these are apportioned from the storehouse account. Powder 1¼ inches, 30 per cent, 1¼ inches, 40 per cent, and 1 inch, 30 per cent, fuse, caps, all are apportioned from the powder account. Next comes lumber and timber, portion used in stopes. Then comes the shops and compressor items, under which are charged the proportion from these accounts. Timbering and Surface Waste items cover the cost of putting in timbers and filling the stopes with surface waste, respectively, and are charged directly to stoping and are not distributed accounts.

The total tons mined and the total cost of stoping are figured, and then from these the cost per ton calculated.

Tonnage and Labor Chart. The most important graphic record is the tonnage and labor chart which is posted in the main office where every one can see it and where it is studied by the shift bosses, the foremen and the other mine officials. On this labor chart in plotting the tonnage a scale of one hundred tons to an inch vertically is used, while the days are plotted at intervals of an inch. This plotting is done on ten scale paper. This scale is good for the Highland Boy Mine, where the tonnage for a day does not fluctuate more than two hundred tons. A curve is plotted for the day shift tonnage and also one for the night shift, then the total tonnage for the two shifts is plotted and also the total tonnage sent over the tramway. This tramway tonnage, as has been said before, is the most accurate of all tonnages. The tonnage mined

is plotted from the estimated weight of a car of ore and the number of cars sent out by that shift. At first there were large variations between the mine tonnage and the tramway tonnage. Now the mine tonnage and the tramway tonnage are quite close together, rarely differing more than fifty tons in a daily output of eight hundred tons. The fact that this report made the men load the cars full has more than paid for the trouble in keeping the reports. Pay day and delays are shown by the corresponding sags in the tonnage lines.

Below the tonnage lines and on the same chart are plotted the number of machines working each day. In doing this a vertical scale of five machines to the inch is used. Curves to represent the total number of machines in use, the machines in ore and the machines on waste are plotted. Below this are plotted the labor figures. The scale used is ten men to the inch. Curves are plotted for the total men employed and the total men employed underground. At the bottom is plotted the tons-per-man curve. These are on a scale of one-half ton to an inch vertically. One curve shows the tons mined per man underground and another the tons mined per man employed about the mine both above and below ground. A scale of one ton to an inch was tried, but this was found to be too small a scale to show variation sufficiently striking.

On this tonnage and labor chart the most important figures in mining are clearly shown so that every one can readily see how efficient the work at the mine is.

Probably there is no better way to get cheap costs than to keep such a labor chart. It shows the efficiency in a department which includes 60 per cent of the total cost of mining. There is only one other curve which might well be added at square set and stull timbered mines. This is a curve showing the number of men on the timber gang. Probably there is no work about a mine where more loafing is done than on the timber gang.

Such a curve in square set mining would also show whether the filling was being kept up with the stoping, for when it lagged behind, the timberman curve would mount as bulkheads became necessary.

Other Graphic Records. In a Number 376 Keuffel and Esser cross-section book, graphic records of most of the principal items in the accounts are kept. These include cost per ton, amount of the straight accounts, distributed accounts, actual total tonnage for each month, actual average tonnage for each day for each month, actual average tons mined per day per man employed, the same per man underground, average number of laborers of each class per day for the month, the average of the total men employed per day for the month, the same figure for miscellaneous labor and also for underground labor. Other curves are plotted for the average number of machines in ore, in waste, and the average number of all machines drilling. In order to check the mine assaying and sampling, curves are plotted for the assays and analysis of the smelter pulp, ore bin samples (grab samples from tram buckets), and the average of all face samples. These generally check quite closely. The sum total of the net debits is plotted and also curves showing the cost per hole drilled by machines, cost per shift, cost per machine, holes drilled per shift, and other data from the monthly machine drill reports.

From these curves by comparing them with other months the officials can tell at a glance how the work in different departments compares with the work for other months. The manager can see at a glance exactly what part of the work needs watching and in case of any extraordinary figures can tell exactly where to look for the disconcerting data without wading through a whole mass of figures and reports. The graphic method of recording the different data increases the value of the cost and data keeping work fully twofold and probably no money spent by the company brings in, of course indirectly, greater returns than that spent in plotting the different data.

Blasting Report. At the mine special provision is made underground to safeguard the men, especially from blasting accidents which, after falls of ground, are the most numerous accidents in metal mines. This Blasting Report shows the number of missed holes and their position while a blue print report, on which is marked the places that are dangerous, owing to approaching work, is also used.

Posted throughout the mine at these places are white painted sign boards on which in black letters is the warning " Dangerous from approaching working." While many of the workmen are foreigners who cannot read English, they soon find out the meaning of these white signs. Possibly a death head and crossbones might give a more vivid warning to any one whether he could read the sign or not.

All development and exploratory work at the Highland Boy is contracted that can be. Often by placing the price just high enough so that the machine helpers will have to aid in running the cars in order that the men can make good wages, the cost of the work can be made considerably less than by day pay, for the machine helper on day pay will only tend chuck and an extra mucker would have to be paid.

Contract Curves. In order to facilitate the setting of contract prices and to aid in judging whether contract work will pay compared with day pay, these curves have been worked out. These curves are plotted in No. 376 K. and E. cross-section books in which the paper is ruled to tenths. The first set that applies to contract work are applicable to any camp, but those that apply to the day-pay work of course are only applicable to camps where the Bingham scale of wages are paid.

On the contract labor chart the scale is $1.00 to an inch vertically, and ten feet to an inch horizontally. The horizontal distance represents the number of feet driven in a week, while the vertical scale represents the amount of money each man on the contract is earning a day. In plotting these curves we have the equation that $ny = mx$, where y is the wage earned by each man a day, x is number of feet driven in a week, m is a constant, the price paid per foot, and n is the number of man shifts worked during a week. This equation is of the first degree and is therefore represented by a straight line.

Consequently in plotting the different lines on these diagrams the greatest distance that is represented is assumed to be the distance driven. This distance and the price paid per foot are multiplied together and then divided by seven times the number of men working on the contract. This gives the wage that each

man would earn each day had that distance been driven. Upon plotting this rate as an ordinate, or vertical distance, and an assumed distance driven a week as abscissa, or horizontal distance, and connecting the point thus obtained with the origin by a straight line, you have a curve which represents all the conditions when that rate per foot is paid.

This curve is useful in many ways. It can be used to tell at a glance what the men are earning from the rate of progress that they are making. Or in setting the contract it can be used to fix the price per foot when one decided how much the men should drive or raise in a week in that rock and what wage the men should be allowed to make a day.

The Pay-Day Curves. The pay-day curves are plotted with the cost of labor per foot as verticals or ordinates and the distance driven per week as horizontals or abscissas. The formula for these curves is $XY = M$, where M is the constant, representing the wages earned in a week by the crew in question, Y is the cost of labor per foot and X is the distance in feet driven per week. This equation is that of a parabola.

The curve is most easily plotted by means of the slide rule and dividing the constant sum by either the assumed distance driven per week, or the assumed cost of labor per foot. The first is the better way as the quotient is the price per foot, and as a tenth-scale paper is used the decimals can easily be plotted.

The pay-day curves are useful in telling at a glance the approximate cost of the labor per foot at the rate the drift is being driven a week and whether it is better to contract the drift. You can also tell how far a contractor would have to drive at any price per foot to make a day's pay. All these curves apply to any kind of lineal advance, whether it is raising, drifting or shaft sinking. The curves are great aids and have been found very useful.

Blasting Report. At the Highland Boy mine there are two bosses on shift. These make out their reports together. One of these reports is called the Blasting Report. [The headings are: — Level, Working Place, Machine Drills (Number Blasting; Time of Blasting), Hand Work (Men Blasting; Time of Blasting), No. Missed Holes Reported, Ready for Timber,

Ready for Track, Is the Pipeman Needed? Remarks.] This report is made out mainly to give information to the other shift as to the missed holes and what is required at each working place.

Shift Foreman Report. The shift bosses together also make out the Shift Foreman's report. This report is merely a labor report and is used to check the timekeeper who goes through the mine during the first part of each shift in order to check up the places where the men are working, so that he can distribute the labor expense properly to the different items in the monthly report. The labor sheet is also used in making up the labor and tonnage chart which is described in the fore part of this article. These are the two principal reports, but special requirements have necessitated others.

Powder Report. The company decided to keep track of the powder and fuse issued to each man. So powder magazines were constructed in different parts of the mine. These are supplied with dynamite and capped fuse by the powder monkey, and they are kept locked. The key is given to some one working in that part of the mine, generally a timberman and less often a miner. This man comes to the magazine an hour before blasting time and unlocks the magazine he is appointed to care for. Then he gives out dynamite and fuse and records the number of the man, the place that the man is working, the sticks of dynamite and the grade, the number of holes drilled, the number of the machine and other data on the form that is called for. This powder report is used in several different ways. It is used for supplying data entered in the Daily Powder Report, also for entering in the record of the individual machine drills, and for distributing the amount of powder used in development work, in exploring and in breaking surface waste; the balance is charged to stoping.

In the above all drifting, cross-cutting and raising in ore, or for the purpose of developing a known ore body, is charged to the development work, while any such work done in searching for unknown ore bodies is charged to exploration.

Tool Sharpening Report. This report was started owing to the large number of drills and tools that were disappearing.

This report is made out by the blacksmith foreman. The blacksmith counts the sharp steel that is sent to each opening each day and reports the tools and drills that are returned from each opening.

These figures are entered in a No. 376 K. and E. cross-section book having columns with similar headings to the blacksmith's report printed by hand in them except that in place of the mine working column there is a date column. These pages are ruled to a tenth scale and are about 6 1/2" × 8 1/2" in size. The cross-sectioning aids greatly in keeping the figures in the columns vertical. In one part of the book a summary of all the workings is kept, while in another part there is an individual record of each working place where tools are received or sent out, the same headings being used as in the summary. These reports are balanced every change day and at the end of each month and the on-hand of all dull and sharp steel in the shop at the first of the month is taken. In this way an approximation is reached regarding the number of tools and drills lost, and also an idea of where the loss is occurring. From this report the superintendent readily learns whether the different machines are being supplied with sufficient sharp steel as well as other information.

The men on the electric locomotive report the number of cars delivered to the tramway bins in the book. The tramway men keep count of the number of tram buckets sent out in another and sample each bucket as it is loaded, while the number of railroad cars and weight of ore shipped to the smelter are also reported in another book. From the different books the figures for these items are obtained for the different reports.

The foreman of the sawmill makes a report in regard to the time spent in framing timbers for the different openings. The machine shop foreman records in a journal the number of each machine received for repairs and the time that he received it. He keeps account of the cost of repairing the drill and finally reports when it was sent back to the mine. The machine drills, to facilitate this recording, are marked with a brass tag screwed to them having a running number. By the number, the make and size of the drill is known as certain ranges of numbers are kept for each size and make of machine used in the mine.

Machine Drill Reports. From this report of the machine shop foreman the monthly machine drill record is made out, using the powder reports to determine in what places the drill was working and who was running the drill. From the powder report the number of holes drilled is also obtained while the machine shop record shows when the drill was sent out and when taken in. Of course the cost is distributed according to the class of work that the drill was working on, and the proper part of the cost of the repairs is apportioned to each account from the percentage of the time that the drill was used on that kind of work. This Monthly Machine Report is kept on a form as shown. [The headings are: — Machine Drill (No.; Name), Where Machine Drill Has Been Used (Level; Working Place; Acct.), Drill Runners (No.; Name), Work of Drill Runners (Shifts Used; Holes Drilled), Total Shifts Used, Total Holes Drilled, Holes per Shift, Date Sent from Machine Shop, Date Returned to Machine Shop, No. of Days in Mine, Date Repaired, Supplies Used (Material; Cost), Hours Labor (Hours; cost), Date Returned to Mine, Distrib. Cost of Repairs, Total Cost of Repairs, Cost per Shift, Cost per Day, Cost per Hole Drilled.] By indexing the numbers of the men working on the different machines a record is kept of the work done by each drill runner.

Sampling Records. At the Highland Boy mine the ore varies in value greatly within short distances, and from its appearance nothing can be told about what the ore will assay. On that account the ore has to be sampled closely; in fact every set of ore mined is sampled. To do this a sampler is employed on each shift. These samples are given a running number and a tag is nailed to the cap nearest the sample. This tag is punched out of linen mapping cloth and is marked with water-proof ink. This has been found to be the best way to mark the position of the samples, although several other methods were used. Besides the running number placed on the sample bag a paper tag containing the position of the set sampled with respect to the zero set, which is carried up from floor to floor, through the stope, is also put in.

The samplers record on a floor map the position of the different samples. On the assay map the final record is made.

The assay results are also written in the shift bosses' and the foreman's pocket notebooks, together with the running number of the sample. They use the tag to find the position of the sample. The assay results are also recorded on large floor maps, and the date of the sampling is also written in each set. These floor maps are kept on loose leaf pages 36 in. × 23 in. The title consists of "Utah Consolidated Mine Assay Map" with headings to designate the Level, Floor, Room, and the Ore body. On the inside end is a 4-in. margin carrying the perforations for binding, while at the outer edge is a 2-in. margin. This leaves a space 29 3/4 × 19 3/4 available for the floor map. This is divided into squares 2 1/2 in. on the side and each of these squares is subdivided into 25 squares so that each set is represented by an area 1/2 in. square. The assays from the drifts, cross-cuts, and raises, which are sampled after each round is blasted, are recorded on assay cards.

Only the average of the assays for the week are recorded on these cards, but the individual assays can be obtained from the assayer's book.

On the assay plan map only the percentage of copper is recorded as the gold and silver contents bear a fairly constant relation to the copper in the ore. After passing through a lean place in the stope, often rich ore is again struck. In fact many new ore bodies have been found by drifting into old stopes and exploring areas marked mineralized upon the old geological maps and the assay plans. This map shows the value of the geological mapping and of the keeping of assay plan maps of each floor. In case that caving were attempted all the advantages of this work would be lost, since at this mine, owing to the fact that all the limestone carries some silica, the silica contents of the ore would be so increased that much, if not all, the gain in cheapened stoping costs would be eaten up by the higher smelting charge.

As has been intimated, geological maps are also kept showing the geological conditions in the stopes, drifts, and raises, the dip and strike of the faults, the position of the different contacts

between quartzite and limestone and of the different monzonite dikes are indicated, especially such areas as show signs of mineralization.

The Drilling Report. Often it is desirable to know what is the assay of the ore being mined so as to regulate the grade of ore shipped in order to take the best advantage of the smelting contract. To do this the form of report called Drilling Report is used. [The general headings are: — Level, Working Place, Big Machines, Small Machines, Single Jackers. For each class of machines there are the following sub-headings: — Place Drilling, Est. Tons, % Cu., Tons Cu.]

The place where the drill is working is determined from the sampler's report, while the assay of the ore in which the drill is working is determined from the assayer's book, or else from the assay plan map. The amount of ore broken is determined by estimation. For large machines in stopes forty tons per day are used, for small machines thirty tons per day, and for hand drilling the amount of ore trammed from each opening. By these approximations the grade of ore being mined is determined and adjusted. Experience has shown that this method is accurate and gives a mixture assaying within a few tenths of a per cent of the grade calculated. These are all the primary reports, from them other reports are made up.

Daily Labor Report. The Daily Labor Report is made out by the timekeeper. This report is used in plotting the Labor Chart already mentioned.

The first column is for the date, then comes labor grouped under the general headings, Day Shift, Afternoon Shift, Night Shift and Total Labor. The sub-headings under the first three are: Shift Boss, Mine Foreman, Timberman, $2.75 Miners, Muckers, $2.00 Miners, Machiners, Machine Helpers, Timbermen Helpers, Total Number of Men, Tons of Ore Mined, Tons of Ore Mined per Man per Shift. [These daily reports are posted to a monthly report.]

Daily Machine Report. From the different mine reports a number of daily reports are made out. The Daily Machine Report is kept on blue print paper printed from cross-section

tracing cloth so as to give guide lines for the different figures, as this facilitates the averaging which is done once a week and at the end of each month. The writing on the blue print is done with caustic soda which gives a white line.

Daily General Mine Report and Daily Labor and Machine Report. The other daily reports are kept in No. 376 K. and E. cross-section books. Each of the two general mine reports takes two of the opposite pages, while in the back of the book is a summary of the different items for each month of the year. The headings of these two tables are given in the following paragraph. These daily reports are totaled and averaged each week and at the end of each month.

In the General Mine Report, the number of cars shipped is obtained from the car book. The tons shipped are calculated from them by using the average weight of a car load of ore as determined during several months. The total number of men underground and also the total employed are obtained from the Labor Sheet. In calculating the tonnage per man the estimated tramway tonnages are used as these are the most accurate figures obtainable at the mine since the average weight of a bucket of ore as determined during several months is used. The underground labor is estimated from the Labor Sheet. The ore sent over the tramway is estimated in the manner already indicated, while the analysis of the ore is that of the grab sample taken from the different buckets at the tramway loading station. The last column [Estimated Tonnage for Month on Basis of Tons Shipped to Date] is calculated from the total tons shipped since the first of the month; this column is important as indicating whether or not sufficient ore is being mined.

In the second report, called Daily Labor and Machine Report, the miscellaneous labor items are obtained from the labor sheet, the data on the machine drills is obtained from the sampler's reports, the weekly advance from the weekly reports of exploration and development, the mine assays from the preceding daily report, and the smelting assays from the smelting reports.

Monthly Summaries. In the back of the daily report book, the summary for each year takes up two pages. The months are the

headings for the vertical columns, while the side headings are as follows: Number of Railroad Cars Shipped, Number of Buckets sent over the Tramway, Estimated Tonnage from Railroad Cars, The Same from Tramway Buckets, Actual Number of Tons Shipped, Per cent Copper in Ore from Bins, Same from Mine Samples, Same from Smelter Pulp, Per cent Iron from Ore in Ore Bins, Same from Smelter Pulp, Per cent Silica from Ore in Bins, Same from Smelter Pulp, Ounces Gold in Ore from Bins, Same from Mine Samples, Same from Smelter Pulp, Ounces Silver in Ore from Ore Bins, Same from Mine Samples, Same from Smelter Pulp, Per cent Lime in Smelter Pulp, Per cent Magnesium in Smelter Pulp, Per cent Lead in Smelter Pulp, Per cent Moisture in Smelter Pulp, Total Miscellaneous Labor, Average of Same per Day, Total Underground Labor, Average of Same per Day, Total Men Employed, Average of Same per Day, Tons per Man Underground (buckets), Tons per Man Underground, Actual, Tons per Man Employed (buckets), Tons per Man Employed, Actual, Average Number of Machines on Waste per Day, Average Number of Machines on Ore per Day, Average Total Number of Machines Running per Day, Advance in Drifts, Raises, etc., Average Tons per Day from Buckets, Same from Railroad Cars, Same from Actual Weight.

VII. Railway Accounts and Statistics [1]

By A. J. County

Railroad management, whether in the transportation, traffic, engineering, finance or accounting departments, is a profession, and the larger and well-established railways begin each year, not only with a record of what has been accomplished in the past year, but with an estimate for the current year made after consultation with the officers in charge of the various departments, covering, first, the revenues; second, a program of maintenance and replacement expenditures to be paid out of current revenues, including therein proper depreciation charges unless sufficient

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replacements are currently made to make good the annual depreciation; third, an approximate estimate of other operating expenses; fourth, an estimate of what should be spent out of current revenues for betterments of and additions to the railway and its equipment, and fifth, a list of expenditures for new railway construction equipment and real estate, chargeable to capital account. Between such capital expenditures, and the maintenance and replacement items charged in operating expenses, are the expenditures above mentioned in "fourth" for betterments and improvements, which run concurrently in making renewals and which it has been the practice of conservatively-managed American roads to provide out of the surplus income remaining after the payment of the operating expenses, taxes, interest on funded debt, rentals, and other obligatory charges.

Such betterments and improvements, provided out of surplus income, may include such items as the elimination of grade or level crossings, improvements in the grades and alignment of the railway and in the yards and terminal facilities and equipment, improvements in the design and character of stations, bridges and other structures, when they are betterments which add nothing to the original plant other than the improvement which progress substitutes for the existing plant, or are necessary to keep the railway and equipment up to the standard fixed by the requirements of its business. These should be capitalizable because they do not substantially increase the revenues, materially reduce expenses, or add an important element of value to the property as a whole. This policy has been pursued for so many years that very few of the standard American railways could now be reproduced for the par value of their outstanding stocks and bonds, and it has been the chief means whereby the bonus stock issued used for promotion rewards in their early history (known as watered stock) have been corrected and the integrity of the capital account restored and preserved. It would be a matter of deep regret if this conservative policy should be disrupted and such expenditures be forced into and retained in capital account by Governmental order.

As the year proceeds, the estimates above referred to are carefully supervised, and additions made to the construction list as

the exigencies of present and future traffic demand of expenditures for branch and relief lines, extensions of terminals, yards, tracks, equipment, etc., upon the recommendation of the responsible officer in charge of that branch of the service, and appropriations are voted therefor by the Board of Directors, or other proper committee or executive officer.

With the question of expenditures for new railway lines, facilities, and rolling stock definitely and prudently decided, taking into consideration not only present but future requirements, for a railroad is a permanent institution, to produce and sell a product called "transportation," the duty of efficient management is first devoted to the quantity of traffic, its movement and the revenues therefrom, and the cost of its conduct — its operating expenses.

It is the duty of the compiler of statistics to separate the different classes of traffic carried and ascertain, as far as it is possible to do so, whether the service is rendered at a profit or a loss. The railroads are, of course, obliged to continue various train service, especially for passenger traffic, and also to carry many items of freight traffic, which on the face of the returns cannot earn enough to pay either their share of the maintenance and operating expenses and other obligatory charges, or their part of the dividend, and must look to the more profitable items for recompense, so that rates are necessarily made on the value of the service rendered and the risk assumed, and not on the cost of transporting each commodity and the classes of passenger traffic. The railways have separated cost to the extent of over two-thirds of their total expenditures between the passenger and freight traffic, respectively, but one-third of the cost, made up of items like maintenance of way, is common to both passenger and freight traffic, and also the taxes, interest on the investment, etc. These common costs have been divided largely on the basis of train mileage, as being the most convenient and, weighing all past and present practical conditions, is perhaps the most acceptable method, although locomotive and car mileage are used by some roads.

The end of this cost accounting will not be reached until the return and cost of every service rendered for both passenger and

freight traffic is resolved into units of lading and distance, reflecting the use that has been made of the equipment, and the service rendered on each of the larger divisions or sections of the railway, and comparisons made with previous years. The railways no longer consist of short lines of single track, which in the earlier days could be supervised by a single officer and a small staff, but of large systems with great stretches of four-track lines. These require for their operation an extensive and trained organization, and the advancement of the art has been so great, due to the provision of adequate facilities and equipment, traffic density, rate changes, and increased taxes, wages and prices of all kinds, that each branch of the railroad business is becoming specialized and the question of costs and net results is reaching the stage of a highly organized industry.

The day of general facts and individual preference in recording results is past, and statistics that fully tell the story and will bear the light of comparison must be kept to justify the efficiency of the operating officer, whose value is demonstrated by the facility and economy with which the traffic is moved, under the particular or peculiar conditions applying in the part of the railway under his supervision, and the operating plant, consisting of the road, stations, shops and equipment, is maintained and operated.

Those lines with which I am most familiar operate the railway by separating it into divisions, each in charge of a Division Superintendent, having full authority, and responsible to a General Superintendent, who supervises several divisions, and who in turn is responsible to the General Manager and the latter to the executive officers. There are, of course, many companies which pursue a different plan of organization, and effect results by different methods and different officers from what I describe.

The three branches of the service — Maintenance of Way, Maintenance of Equipment (rolling stock), and Transportation (train movement) — are confided for results to a Division Superintendent having anywhere from 150 to 250 miles of main railway mileage, with branches, or a total track mileage, exclusive of sidings, of from 500 to 750 miles, depending on the traffic density and the district served. Having the largest share of the operating

expenses, the operating branch of the service is at all times subject to the greatest cross fire.

This quickened responsibility led to a demand that operating statistics and costs, which formerly were compiled in copperplate fashion after the close of the month, should be promptly furnished so that defects could be remedied, for the results of train, car and tonnage movement and costs must reach the man in charge promptly after the train movement occurs, otherwise a railroad in operation may soon deplete its revenues by the heavy expenditures for labor and materials, for unremunerative train and car mileage, and unless the cause is very marked, and the inquiry promptly follows the cause, the management can obtain only a general explanation for bad operating results instead of the conservation of its funds. Taking the experience in 1907 as an illustration, when conditions changed from high water mark of traffic in the beginning of the year to a business depression in the latter part of the year, the operating officer could not immediately decide exactly where and what expenses should be immediately reduced without facts promptly furnished to supplement his judgment. It therefore became a matter for decision as to what statistics were required to give a division officer adequate and prompt control of the situation and to have his expenses well in control.

The maintenance of way and structures and maintenance of equipment expenses, amounting to 42 per cent of the total expenses, are governed, first, by the definite program allowances made at the beginning of the year, and these or the other program allowances mentioned are not exceeded except for special purposes approved by the chief executive officer in charge of operations, and, if of sufficient importance and not the ordinary and necessary expenses for upkeep, require approval by the President and the Board. These program estimates are based on and compared with similar expenses and costs of previous years on various bases, so that any unusual features of increase or decrease must be fully explained before being authorized. The changes in division superintendents or other officers on a large and active railroad give a fresh view of this

question at least every few years. The division or other officer must make his program estimates based on personal knowledge and on the information given him by his staff, composed of men trained in each branch of the service, and they are subsequently subjected to the scrutiny of the General Superintendent, and, in the case of maintenance of equipment expenses, to that of the respective superintendents of motive power, the general superintendent of motive power, or other proper officer in charge of motive power, and in the case of maintenance of way and structures expenses, to the Chief Engineer of Maintenance of Way, and finally all such reports are scrutinized by the General Manager. It is clear that after so many trained men have given their experience, it is difficult to go far astray in a proper annual expenditure, especially as after its authorization its outgo is carefully guarded, and is subject to the orders of the division officer or his responsible assistants in charge of railway and structures and in charge of the equipment handled in the shops. There is also included as part of the maintenance and operating expenditures a charge to provide for the replacement of the equipment.

So far as expenses for maintenance of tracks, bridges, stations and structures, and maintenance of equipment are concerned, which amount to about 42 per cent of the total operating expenses, they necessarily are related to the extent of the train service, yet if business decreases and does not justify it, a very large part can be deferred, provided the railway and equipment has been heretofore maintained in good working condition and repair.

Little credit has therefore in the past been given for reducing maintenance of way or equipment expenses because it has been the favorite method of "skimping the property," whereas reduction in transportation (train movement) expenses is regarded as an indication of efficient management; but now that all expenses are shown in detail in the railway reports and comparison with the previous year, one is enabled to locate the items in which the saving has been effected and prove to a certainty that such has been the case, so that the old time charge of "skimping the property" by neglecting or deferring maintenance or

other expenses can no longer be made unless proven by actual results.

In transportation expenses, which amount to 51 per cent of the total operating expenses and are so largely dependent upon the train movement, costs of labor and supplies, and traffic density, it is more difficult to effect economies without the closest supervision. In this branch of the service, it is very clear that results must promptly be in the hands of the Superintendent, or labor costs, improper train loading, slow movement, and excessive mileage will seriously interfere with the results. All of this means close watching and the necessity of quickly obtaining unit figures as a warning and comparison.

Since two-thirds of the revenue of the American railways arises from freight traffic, it is not surprising to find that so much attention is directed to operations in that service. The proper officers, with their staff officers and others concerned, have constantly before them telegraphic reports of yard and road conditions; also reports for slow freight trains, showing the number of trains, number of cars, gross lading of each car, train mileage, running times between terminals, average speed, gross ton mileage, i. e., weight of car plus lading, and also the potential ton mileage, which in effect is the maximum which the engine could have hauled under ideal conditions. This is given for comparison with actual gross ton mileage as regards efficiency. As there are many fast freight trains containing lading of a perishable nature which must be run at a fast speed, independent of lading and other conditions, he also has a statement of the gross ton miles of all freight trains and the car mileage, loaded and empty, and the total, and percentage of loaded and empty cars.

The greatest attention is paid to the lading of the trains so that economical movement may be made and payment of overtime and other expenses avoided. The daily report of the movement of loaded and empty cars past junction or other strategic points, where trains mass in reaching a terminal, showing comparisons with similar previous periods, gives one of the first clues to the business of the day and is about the quickest statistic telegraphed; then comes the weekly return of revenues, divided

between freight, passenger, mail and express traffic, the freight often being divided between general merchandise and mineral traffic, and for many roads this weekly information, although approximate, is published in the newspapers. Passenger-train lading and results are closely watched, and the Superintendent keeps in close touch with their movement and car mileage. Further, for passenger trains, it is the custom with many roads to take the earnings of each train as often during the month as necessary to insure reliable results and use them in reaching conclusions as to whether trains should be removed or the service supplemented. A statement is furnished monthly of tonnage of principal commodities moved on the divisions. The monthly income account of revenues and expenses for each company and each division, and summarized for the company as a whole, and with the necessary addition of other income and the deduction of fixed charges and other obligatory payments, gives the first idea of total net income compared with the same month and with a similar period of the previous year. Statistics of cars, tons and passengers moved from the principal stations; statistics of tonnage and passenger mileage, including the average rates, costs and profit or loss per mile from each ton and passenger; and the earnings, expenses and net revenue or loss per train mile. All of these statements are made up by divisions and comparisons and explanations required of the various increases or decreases.

This information at the close of each month in the hands of each operating official resolves itself down to the following facts compared with the same month in the previous years: Number of locomotives in service of various kinds and the percentage in good condition, locomotive mileage of all kinds, average locomotive mileage in the various branches of service, average mileage between shoppings for repairs during the month and the two months preceding; passenger car mileage, average number of cars per passenger train, passenger train detentions due to locomotive failures or car failures; freight car mileage, east, west, north and south, loaded and empty, and the percentage of both; average number of cars per freight train; total gross ton mileage; average gross ton per freight train and per freight car; ton

mileage; average speed; percentage of passengers and freight trains on time.

The above statement does not require the compilation of operating costs, but closely following it is required a statement of operating costs, worked out upon the following basis:—

Coal consumption; consumption of waste and lubricating material; cost of certain passenger (based on 1,000 passenger car miles) and freight (based on 1,000,000 gross ton miles) expenses, including coal for locomotives, wages of enginemen, firemen and trainmen, and supplies furnished trainmen. Cost of certain yard expenses (based on each 1,000 cars dispatched from the yard), including yard locomotives, wages of enginemen, firemen, conductors and brakemen, supplies (except for enginemen and firemen), yard masters and their clerks, yard-switching and signal tenders. Cost of locomotive supplies furnished enginemen and firemen per locomotive in service; engine-house expenses per locomotive handled; locomotive repairs per 100 locomotive miles. General movement expenses per 100 locomotive miles, covering lubrication, water, fuel, and other supplies for road locomotives, repairs, renewals and depreciation of road locomotives, engine-house expenses for road locomotives, road enginemen and trainmen, train supplies and expenses.

As this information covers matters controlled largely by the several division superintendents and their staff officers, and is compiled in the early part of the month following that in which the expense was incurred, with the approximate expenditures for labor and material, the remedy is largely first in their own hands, but does not remain there, for the higher operating officers are subsequently furnished with the same information arranged to suit their purposes, and explanations as to good or bad results are demanded. The management further exercises its influence on expenditures dependent on many other conditions, such as the present or anticipated financial and industrial conditions. The results of each month's workings of the respective divisions, including all charges whether entirely under the Superintendent's control or not, are sent to the Superintendent and other proper officers of the operating and traffic departments to arouse

their responsibility and encourage their efforts to obtain more business, or greater promptness and economy in the movement of the business on the line, and to earn their proper proportion of the fixed charges, dividends that should be paid, and amounts that should be provided for betterments out of income. It is essential that the statistics of cost to be put in possession of a divisional operating officer should first be those over which he has control, that he may apply proper remedies for unsatisfactory performances brought to light by equitable comparisons, but such officers should not be allowed to forget that other charges, such as taxes and interest, exist which are not chargeable to expenses and that dividends should be earned and paid. Statements of the unit costs of handling tonnage, passengers and baggage at the larger stations are also prepared and sent for criticism to the various officers, and to ascertain why costs are higher or lower at one station than another. On some railways, the chief features of expenditures are also exhibited by chart and diagrams so that vivid pictures as well as figures may drive home the facts. There are now on several of the operating staffs officers who are charged with the duty of supervising operating costs of all kinds, including shop results, and to ascertain by personal examination and conference why better results cannot be obtained, and create a wholesome spirit of emulation among the various officers and divisions to bring about these results. I do not wish to convey the impression that all the railways in the country compile and use all of the foregoing facts, or that the American railway officer spends the most of his time sitting at a desk, wearing a pair of spectacles, digesting railway statistics or has any greater love for them than officers in other countries, but in so far as they are of assistance to him, he must, and does, study railway statistics. Constant and personal familiarity with his operating, division, or departmental work, with the assistance of a trained staff, enables him to discern promptly any danger signal of loss of business or excessive cost. As the result of an evolution in a chain of progress of which he is a part, he must and does profit by statistics, and improves the situation by direct and immediate action taken on the ground as the result of his con-

sideration, or if he cannot do so, is in a position to report to his superior officer reasons for such inability and receives the results of the more extended experience of the latter, who will also probably warn other officers.

I make no reference to the large number of reports concerning the daily operating routine and management because they have become standard, and relate to different features of the railway—ties, rails, its equipment, supplies, shops, signals, and interlocking, tests of all kinds; or to the special studies as new problems arise. These are all taken for granted as being necessary in every country.

The statistics and other information furnished by the officers, agents and employees of each division must be such so that when supplemented by the fixed charges and other obligatory payments and dividends disbursed, the comptroller, auditor, or general accounting officer may compile therefrom the respective monthly and annual reports to the stockholders and to the National and State authorities, and must comprehend the statistics hereinbefore indicated.

I need not advocate the necessity or advantages of a uniform system of accounts or statistics, for that is behind the railroads in North America, which are devoting their energies to settling the few remaining points in connection with the prescribed accounts, in such a way as to make the system finally effective and adapted to the varying interests of the weak as well as the strong roads, and to those companies which must observe special charter requirements of the States or Provinces in which they are incorporated. That such advancement has been made is not due to any inherent virtue in American railway management, but rather to the necessities of development and management already alluded to, which were stronger than any inherent inclinations.

The experience of American railways removes all doubt as to the results achieved by vital statistics, in the hands of those directing and operating the various lines. Rates have fallen, operating expenses, taxes and other charges increased, but the growth of traffic has been handled with greater economy because the operating and traffic officers had full statistics for their con-

stant reference and warning, and these statistics were available for use in various forms very soon after the traffic was moved or the expense incurred. The remedies have been applied in the shape of larger cars, larger train loads, and cars constructed of more durable materials, larger and more scientifically designed freight classification-yards and facilities, and the use of a large part of the surplus income for improvements of the grades, alignments and facilities, thereby restricting capital charges and making dividends a permanent feature by deferring them until the condition of the railway and its equipment justified their payment.

In stating these facts, I do not lay claim to any superiority for American methods, nor am I oblivious to the progress in accounting and statistics made by the railways of other countries, from which we may learn a great deal.

The railroads in North America have by consolidation and affiliations developed into large systems, each embracing from a few thousand to several thousand miles of main running tracks, so that it is impossible to manage them efficiently without the assistance of vital and comprehensive accounts and statistics of the service performed, the volume and character of the business done, the revenues, costs, and net revenues therefrom, and comparisons with other periods compiled in such a way as to aid the efficient direction and management of the property, by quickening responsibility from the highest to the lowest, and from the lowest to the highest officer. In America, there is less time and no more money to be wasted on statistics, unless useful, than in any other part of the world.

(*a*) I take the broad ground, and from the list herein stated it will be conclusive that no special statistic is believed to tell the whole story without others to supplement and correct it. All statistics kept should demonstrate their utility, and if not demonstrated should be abandoned. Scarcely any two officers derive a like value from a similar statistical statement because of their personal characteristics and service in which they received their training, or because the traffic or problems of their respective divisions differ radically. (*b*) No matter what statistics are pre-

pared, it will always require: (1) personal knowledge of the road, its traffic, working conditions, all standards properly to interpret them, so that they will act as a guide, and quicken that responsibility which results in efficient operating results, and (2) men of ability, experience and loyalty to produce such results. These results cannot now-a-days be achieved until the sense of responsibility and some sort of comparative costs and results are given to foremen, section men, station masters, yard masters, agents and train masters, as well as officers, so as to give them facts covering the cost of labor and supplies involved in their own work, and gradually interest them towards greater efficiency by eliminating waste of materials, time, and effort. This field is still a large and fruitful one, and the costs involved are too large to take chances on results. (*c*) Unless statistics reach operating, traffic, and administrative officers within a relatively short time after the operations have taken place, their value is largely lost, and they then serve purposes of record only. This can only be done, without duplicating working forces, by the close working of the operating and auditing officers. (*d*) Each operating and traffic officer should have one or two recognized daily statistics, summarized by weeks and for the month, agreed upon with the auditing officers, depending upon the character of the division (i. e., whether it is one fed by traffic from other divisions, or is a division located in strictly competitive territory where traffic originates, or has other special features) to keep him in touch with actual operating conditions upon his division affecting operating efficiency and costs. The poorer the railway, the greater the necessity for knowledge of this character, and the greater the necessity for coöperation between operating traffic and accounting officers. When weekly or monthly statistics for a division are furnished, a separation should be made between the statistics subject to the control of the operating officer from those over which he has no control, or only partial control, and a clear comparison of both sets of statistics given with a similar month and period in the previous year. Divisional operating officers, through the medium of monthly divisional income and expense accounts, should be given the facts regarding the proportion of

the fixed and other obligatory charge of the company which the earnings of their division are expected to meet, over and above the operating and maintenance charge. The latter quickens a responsibility for earning a good margin over operating expenses, and broadens the view of the officer. (*e*) A definite classification must be uniformly observed so that the statistics will at all times convey the same meaning and insure proper comparison with the same items for similar previous periods of the same road or division with itself but not necessarily, however, with those of any other railroad. (*f*) Railway revenues and expenses should be absolutely separated from all other operations which the company conducts or in which it is interested. (*g*) In no system of uniform accounts should the desire for special information by railway or government officials lead them to make arbitrary decisions which strip the operating expenses of everything except bare maintenance charges, and force all above that into the capital accounts. In the interest of the public and the railways the capital accounts should be limited as much as possible, and every encouragement given to make adequate charges to expenses, since all transportation officers naturally try to keep their expenses down rather than up, and so prove their superior operating methods. Charges in excess of ordinary maintenance can be so shown in the accounts that uniformity will not be outraged. In the desire to standardize accounts, the efforts should be confined to principles and not to details of management, for it must be remembered that each railroad is a problem, and any attempt to mould all railroads to one pattern will eventually be found ill-advised on the part of the regulator, hurtful to the regulated, and an incubus on individual and corporate efficiency. (*h*) While the American accounting and statistical system is not absolutely perfect, I do not know that it is excelled anywhere. It has proved its benefit to the railroads, and enables investments in railroad securities to be made on a clear knowledge of the physical and financial conditions of the companies.

The railways and their transportation services are deemed to be of a public nature, because the State confers upon them the power to condemn and appropriate land for their purposes subject to

the payment of the proper value therefor, and because of the dependence of the community upon the transportation service. So far as the right of eminent domain is concerned, the railways avail themselves of it only as a last resort, after exhausting private negotiations, because of the excessive prices awarded by court juries or commissioners compared with the actual value of the land. Although the railways are privately owned, they are nevertheless granted this right because the use of the land is for the public benefit. The real reasons why the railways are a public benefit are because (1) they enrich the landowner from whom the right of way must be purchased; (2) they create wealth for the State, municipalities, and country through which the lines are constructed, by furnishing the means for the development of natural resources, manufactures, and other commodities, quickly and cheaply bringing them to the proper market; (3) they increase the revenues of the community by liberal payments of taxes; (4) they constantly enlarge and improve their facilities; (5) they precede instead of follow the settler, thereby stimulating population and greatly extending and serving the wants of the community as well as adding to the ability by which such wants or luxuries are supplied and satisfied; (6) they furnish a reliable avenue for investments of home and foreign money and steady employment for large bodies of all grades of laborers, artisans, clerks and professional men; (7) and they open a large and constant market for all kinds of materials and supplies consumed over an extensive area.

Their permanence insures prosperity to the community and while other industries may come and go with only a temporary or partial effect, all suffer when the transportation service ceases or becomes insufficient.

It would be idle to deny that we are living in a new era of progress, in which the standards of living and practice have been materially improved, and railways and other transportation agencies have played no small part in disseminating these higher standards of living and intelligence throughout the world. They minister to the supply and demand of the whole world, break down the barriers of racial prejudice and provincialism, especially

the railways in a country of extensive natural resources and population like North America, and nothing can permanently affect the existence of the railways, the service they render, or the charges for such service, that is not communicated to those countries who look to it as the sources for agricultural, mineral, forestry and manufacturing products and to their citizens who have invested their capital therein.

These factors have created a demand in all countries for the standardization of railways as well as inquiries regarding their operating and financial results, and for the use of standard units by which these results may be conveyed in unmistakable form and substance. Uniformity of accounting and statistics will never admit of an actual and final comparison of one railway with another without a full knowledge of all the facts and conditions, nor will average statistics ever form a reliable rate-making basis, although in the days of keen competition these figures were a guide to that end and when uniformly kept for a series of years are a great advantage. It would nevertheless be a distinct gain to the railway profession, to those whose moneys are invested therein, and to the governments from which railway powers are derived, if this responsibility were so appreciated that a uniform system of railway reports and particularly a uniform system of operating statistics, so far as the same can be made uniform, were to be adopted by the International Railway Congress.

VIII. Railroad Statistics [1]

By A. A. Goodchild

Statistics have been defined as "the disciplining of a property." They may be said generally to group themselves into two classes. In the first class are those which show results of operation, such as the more general statements found in annual reports; in the second class, such statistics as are devised for the purpose of checking details of operation with a view to improving results. It would be impossible in this paper to discuss all phases of railroad

[1] *Railroad Gazette*, vol. 40, No. 3, pp. 65–68. Reprinted by permission of *Railway Age Gazette*. Illustrations of forms are omitted.

statistics. The field is too large. We must pass over such incidentals to a large railroad as the newsboys, sleeping and dining cars, telegraphs, hotels, dining rooms and steamships, which must all be scrutinized and analyzed in order to satisfy the management that these various branches of the service are being operated satisfactorily. Every station on the line must have its records laid bare and every phrase of revenue must be looked after. Do receipts per passenger or per ton of freight keep up? What are the causes for the upward or downward tendency in the ton-mile or passenger-mile rate? What is the average journey per passenger or average haul of merchandise? Are too many cars or trains being run for the amount of business being done? Are the freight cars properly loaded? Is there cross-hauling of empty cars? What is the percentage of empty to loaded cars? These and many other similar questions are the stuff of which statisticians' dreams, and some railroad officials' nightmares, are made; questions which require an answer, not only for the entire road, or for a superintendent's division, but for a superintendent's district or an operating section of that district.

From 60 to 70 per cent of the entire operating expenses of a railroad are made up from payrolls, and the importance of closely watching the returns pertaining to these payrolls, whether the outlay is incurred in the direct production of revenue, or for the purpose of keeping rolling stock and roadbed in proper condition, cannot be overestimated. The large items of payroll expense are, of course, trainmen, enginemen and station agents. Trainmen and enginemen are well taken care of by comparison with train or engine mileage, and station agents by comparison with the amount of business done at the individual station. The staff necessary for the upkeep of roadbed, buildings and bridges is largely fixed by the management, and the necessary authority or appropriation granted for any work of a special nature as distinct from the general working expense. Roundhouse expenses can conveniently be set off against the number of engines dispatched and boilers washed, while the wages paid for maintenance of equipment may for general purposes be compared with the mileage made by cars or locomotives. This latter expense, how-

ever, should be considered for a series of months, rather than for any particular month, because cars and locomotives are, as far as possible, repaired when least required for business on the road. Provided a railroad keeps a separate record of its running repairs as distinct from its heavy or shop repairs — a practice in every way desirable — the running repairs can safely be criticized each month, by comparing the outlay with the work performed. In this connection, it would be well if the master mechanics at their next annual convention should place on record their views as to what properly constitutes a charge for running repairs for both locomotives and cars. The various roads would then have a fair figure by which to compare themselves with each other, providing, of course, that the basis for arriving at the work performed was uniform. With locomotives it should not be a difficult matter to arrive at a standard basis. If a running repair was understood to include all repairs costing $100 or less for labor, and the 100 per cent capacity-mileage, hereafter referred to, was recognized as the standard unit, a good basis of comparison would at once exist, namely, cost of running, and by deduction, other repairs per 100 per cent capacity-mile. With cars, the problem differs somewhat, but there does not appear to be any insuperable difficulty in handling them on a similar basis, by defining a running repair, and also fixing upon a unit of capacity similar to the 100 per cent locomotive-capacity. Of course, the large number of cars in use complicates matters somewhat, and the suggestion is put forward with a view of getting this question discussed.

Such statistics as are necessary for the purposes above outlined are more or less of a general nature, and their value to the management of a road is much or little, just so far as the detailed analysis of the various comparisons is comprehensive, and no farther. Considerable time of officials and their staffs is frequently lost in replying to criticisms based on such general statistics, due to the immature condition or lack of detail back of them. Instances are not rare where an official has been roughly handled by the management for an apparently poor record, for which, upon investigation and more complete analysis of the situation, he has been completely exonerated. This, after labor-

ing under a stigma extending anywhere from a week to two or three months, almost insensibly tends to harden that official's mind against such general statistics, whereas with proper data available in the first place, the loss of time and annoyance would have been avoided.

When one speaks of statistics, the inference is almost natural that train and locomotive performance are specially implied, and while each of the matters already touched upon affords a large field for discussion, the fact is that of all branches of statistics that relating to train and locomotive movement is the most important. The revenue derived from freight traffic usually represents about 70 per cent of the entire revenue of an American railroad, and while the expenses incidental thereto do not form such a large percentage of the total operating expenses, the proportion is sufficiently large to demand the closest possible analysis. Passenger business is to some extent the creature of circumstances; it is also in part governed by local conditions or considerations, and whether a train pays or not, it sometimes happens that legislative requirements, or the irresistible demands of an enlightened public, compel a company to furnish service not warranted by the financial returns. Competition also sometimes has here an important bearing. Owing to these special conditions statistics relating to passenger-train performance have not the same disciplinary value as have those relating to freight traffic; but while these conditions exist there are certain features of passenger-train work which cannot be overlooked, such as comparative fuel performance and repairs, and subsequent reference to these branches of statistical information for the freight train service may be applied to that of passenger trains also.

Until within a comparatively recent period it was considered sufficient to know only the distance traveled, as shown by train and locomotive mileage, to criticize confidently a superintendent on his train performance, or a master mechanic on his locomotive performance. Train mileage at first glance looks innocent enough, but has proved misleading. It does not take into account the number of cars in a train, and it ignores the fact that perhaps two or three engines were used to haul the train, one possibly capable

of hauling 3,000 tons, while another could handle only 1,200 tons. More than this, statistics based on train mileage fail to furnish any information as to the financial benefits obtained by outlays of capital for the reduction of grades and curves, or to supply any basis for arriving at the saving in cost of transportation effected by the introduction of larger-capacity locomotives and cars. Locomotive mileage, as a basis of criticism of locomotive performance, has also signally failed, for similar reasons. With the large investments of capital made during recent years for the purchase of large-capacity locomotives and cars, it was but natural that the cost per train or locomotive mile should show considerable increase for fuel and repairs, and it was necessary for a new unit to be introduced which would contain at least the elements of weight and distance, and so we have what is called the "ton-mile" unit. This unit, when used in conjunction with train or locomotive mileage, has now become the principal basis of analysis in the railroads on this continent, and by its use it becomes possible to arrive at the results obtained from capital investments for the betterment of the line, and to obtain a fair index of operating efficiency on individual sections of a road.

The need for a unit which should combine the features of locomotive-capacity, tonnage hauled and distance traveled, became evident as soon as modern large locomotives began to be used, for it was found that the superintendent who happened to have the larger power on his division could do all the shouting when it came to a question of the size of train, or of tons hauled per train mile; and while it was a simple matter for the statistician to explain that Mr. Jones ought to make a better showing than Mr. Brown, because he had larger engines to work with, it was not considered good statistics to stop there, for there was a possibility that Mr. Brown was really doing better work than Mr. Jones, considering the power at his disposal. Such a unit was designed and put into use on the Canadian Pacific by the writer, nearly three years ago, and was called the 100 per cent capacity unit. It was decided that the only fair way to deal with the question was to bring all available power to the 100 per cent basis which

represents 20,000 pounds pull on drawbar; show the quantity of power each superintendent had to dispose of, and set off against that quantity the actual work performed. Incidentally it might be said that this unit has proved a valuable one for purposes of comparison in connection with locomotive repairs. Another question still arises: "What percentage does your actual freight ton-mileage bear to the potential freight ton-mileage?" In other words, if a 150 per cent engine is capable of hauling 2,000 tons over a given section of the road, 100 miles long, at an average speed of 12 miles per hour, it has a potential freight ton-mileage of 17,280,000 ton-miles per month of 30 working days of 24 hours each. We all know that a large portion of an engine's time is used up in the roundhouse or shops for repairs, a considerable portion occupied in taking on fuel and water or in switching and light running, but were the actual percentage of lost potential power figured out the results would probably be startling. Why not compare one superintendent's division with another on this basis for a month every now and then?

Very few roads are as yet taking any cognizance of the matter of "speed" in their statistics. A unit which will incorporate this factor is not only desirable, but imperative, for it carries in itself reconciliation of those diverse interests, the transportation and mechanical departments. Under the present system, an engineer who brings his train in on schedule time, and transforms his power into speed, frequently finds it necessary, in so doing, to make increased demands on the coal pile and "his ton-miles per ton of coal" presents a wretched appearance. The superintendent or dispatcher discovers a "gem" of an engineer, while the master mechanic puts a big black mark against the performance. *Per contra*, the engineer who converts his power into load is a model driver from the master mechanic's point of view, but the superintendent will probably avail himself of the first opportunity of calling him down hard. The engineer naturally becomes discouraged, and may be pardoned if his language is more forcible than polite with reference to statistics in particular. What is necessary is a unit which will give the engine and the engineer

credit for the full amount of power expended, both in attainment of speed and hauling of load, and the opinion that such an unit would be found by taking the minutes occupied in actual running between terminals and dividing the figures into the ton-miles hauled per 100 per cent of capacity seems justified. It might be called the "operating unit." Fuel, or pounds of coal used per operating unit, should then furnish statistics, satisfactory at once to the mechanical and transportation departments.

There is one other suggestion with a view of bettering present day methods, and it relates to the direction of traffic. Most roads divide their statistics as between east and westbound or north and southbound. Such division may be useful as denoting the general trend of traffic, but it seems more than probable that a further subdivision setting forth such traffic as in the direction of the balance of traffic, as distinct from that in the direction of returning power, would be a better basis from which to criticize locomotive or train performance. With the present system, assuming the balance of tonnage for an entire month is eastbound, it is possible that during a large portion of the month the balance was in the opposite direction, and, as a consequence, eastbound results as shown are misleading, and the good actually attained by careful loading, proper handling of empty cars, and economical fuel performance is largely lost sight of. The tonnage rating system in use on the Canadian Pacific was fully discussed by Mr. Thomas Tait in a paper read before the New York Railway Club in January, 1901 (*Railroad Gazette*, Jan. 18, 1901), and it is not necessary to refer to the matter further than to state that with the aid of tables or charts, which are available for the use of all transportation officials and employees, it is simply a matter of reference to determine the size of load an engine of any capacity should haul over any section of the entire Canadian Pacific system. The engine capacity can be found by reference to the engine list printed on the cover in which these charts are bound, the figures being arrived at by the generally accepted formula for single expansion locomotives $\frac{C^2 \times S \times P}{D} = T$ in which

C = Diameter of cylinder in inches.
S = Stroke of piston in inches.
P = Mean effective pressure in pounds (85 per cent boiler pressure).
D = Diameter of driving wheels in inches.
T = Traction power in pounds.

Mr. Tait's paper also explained the method by which the prescribed allowance for the extra resistance due to the proportion of tare being greater than one-third of the actual gross tonnage, and the figure termed "equivalent tonnage," is arrived at. This "equivalent tonnage" is used not only for the proper loading of engines, but as a basis for criticizing the engineer's fuel performance, and with such an equitable figure, the excuse that "my train was all empties, while Bill had all loads and ought to have a better record than I," cannot be advanced.

The importance attaching to an economical fuel performance is manifested in the close attention which is being given to the question by all railroads, and when the vast amount of money involved in the item of "fuel" is borne in mind such interest cannot be wondered at. Many devices have been invented with a view to securing correct returns of fuel consumed, and apart from the methods of delivery, which is a problem that railroad managements must themselves be satisfied upon, the question of accounting for deliveries as recorded is one of considerable difficulty. This is done on the Canadian Pacific by an "enginemen's trip ticket," form 67E. On the lower portion thereof is the fuel coupon "C." This ticket is made in triplicate, the first two sheets having carbon backs. The book of tickets belongs on the engine and must not be taken away by the engineer. When a quantity of coal is put on a tender the fuel man enters the amount on coupon "C" 1, and tears out the duplicate copy, which is forwarded to the fuel department as a voucher. At the end of the trip the engineer estimates the quantity of coal remaining on the tender, and records same in space provided on coupon "C." He then deducts this from the quantity shown to be on hand at the commencement of the trip, thus

arriving at the quantity actually used, which he also enters in the space provided. The entire front sheet of this ticket is detached and sent to the statistical office by first train, after having been noted and approved by the locomotive foreman at destination point. Questions sometimes arise as to the correctness of the estimate of quantity left on tender by the engineer making the succeeding trip, against whom such quantity is charged; but the locomotive foreman or hostler has authority to settle such differences of opinion, and disputes are not frequent. When it is stated that, with the use of this ticket, the figures arrived at by the statistical officer show variation of considerably under 1 per cent with those of the fuel department, it would seem that the question of accounting for fuel issues has been practically solved.

Oil and waste supplies for locomotives are handled in a somewhat similar way. The oil coupon " B," on the same trip ticket, is made out for the necessary supply of oil, and is signed by the man who receives it, and coupon " B " is detached from the second sheet as a stores-department voucher. It has been found convenient for the statistical office to accept the statement of issues as compiled by the stores department from these coupons, rather than make up an independent record, but it is at all times a simple matter to check either the stores or fuel department's charges by referring to the tickets. The question of devising some method of checking the quantity of the different kinds of oil used more effectively and simply than the present method of figuring the miles run per pint is occupying attention. The Canadian Pacific has in use what is termed an excess oil ticket, and if an engineer requires a quantity of oil in excess of the schedule allowance for the run, he must fill out one of these excess slips and hand it to the locomotive foreman for approval, with a brief statement of the reasons for his requirements. Should the locomotive foreman approve this slip, he makes a requisition on the stores, and sends the approved slip to the divisional master mechanic, also a copy attached to the trip ticket to the statistical office. All of which routine is assumed to act as a check on the demands for " more oil." Mr. Vaughan has recently suggested

a statement to take the place of the present record, which will show "quantity used," "quantity as per schedule," "quantity issued on excess slips," and "quantity used less than schedule allowance," also the percentage which the last two items bear to the authorized or schedule allowance. A statement of this sort would not involve as much work in compiling as does the present one showing the "miles run to a pint," and the expensive engines or engineers could readily be detected by simply glancing down the column "percentage of excess." "Miles run to a pint" does not represent anything unless you know how many miles should be run to the pint, and this proposed method has the appearance of being very nearly a solution of an old standing difficulty. The unused coupons of the engineer's trip ticket are disposed of as follows: Coupon A2, enginemen's record of mileage, is retained by the engineer, while the oil and fuel coupons B2 and C2 remain in the book, which is turned into the locomotive foreman at the roundhouse to which the engine is attached, at the end of each month, or as soon as all tickets are used, to be retained by him for reference or check, should any questions arise as to the correctness of the performance sheet.

Statistics, to be of value, should be subdivided in such detail as to furnish the results of operation on the smallest subdivision of a railroad. With the Canadian Pacific this subdivision is represented by engine districts, which average from 100 to 120 miles. Comparisons of performance should only be made by one district against itself, unless it is known that the conditions are similar in another district. A study of this matter of comparisons leads one to the conclusion that much valuable time is lost by endeavoring to compare results of trains on one road with another, or even one division with another. Weather conditions, water, grades and fuel, have each a share in producing differences in cost which it is difficult to estimate, but apart from this, there is an even more serious difficulty in making comparisons between two or more railroads. The data used in compiling results are rarely available, and when available are still more rarely harmonious. By comparing one division or district with itself for a corresponding period the difficulties of water and grades are largely elimi-

nated or at all events any change is on record, and fairly reliable conclusions may be drawn from such comparisons. A locomotive-performance sheet should be so arranged that all the engines on a district be shown side by side, preferably in order of capacity, and separately for each class of service. This arrangement enables one to appreciate correctly the relative economic value of the different types of engines. It has been a pleasure to the writer to see the practical use to which such an arrangement of records was put up by Mr. Vaughan in his very able paper on superheaters, for without any further need than a reference to the regular monthly performance sheets of the Canadian Pacific it was possible to arrive at exact data regarding the performance of superheated locomotives and compare them with other locomotives of similar capacity not equipped with the superheater devices.

The forms used by the Canadian Pacific in compiling and reporting train and locomotive statistics may be briefly described. The conductor's journal, form 125, in conjunction with the engineer's trip ticket, already described, is the basis of the entire records. The necessary information is abstracted on form S.O.1 and worked up on the train and locomotive-performance sheets. Each engine on each section of the road is given a separate card (form S.O.1) for each class of service in which it is engaged, provision being made on the top of each card for the engine number by a series of "tags" running from 1 to 10 — for the last figure of the number. This card is opened from the train dispatcher's sheets, the first entry being the date of trip which is taken therefrom. The engineer's trip ticket is then taken and the fuel used on trip entered, while from the conductor's journal is entered all information relating to train and locomotive mileage — car mileage, tonnage, etc., as provided. This method ensures a triplicate check of the entries on the card. At the close of the month or week, or as often as such record is required, the cards are added up and the locomotive-performance sheet (form S.O.60) is compiled directly from them. This sheet can be issued within two days after the close of the period for which such information is desired. The generality of locomotive-performance sheets show

"cost" of fuel and supplies against each engine. Such information is unnecessary. The man operating the engine has nothing whatever to do with the question of "cost," but simply "quantities" used. Form S.O.62, the summary of locomotive performance, properly takes care of all expenses incident to the work performed, including repairs. Apart from the consideration of total cost of repairs compared with the total work performed, all details pertaining to repairs should be dealt with directly by the mechanical department. For the train-performance sheet, the various items of performance of all trains operating on each section are summarized, and the totals of these sections represent the work done on a superintendent's division. A summary is then compiled of each general superintendent's division showing the totals of each superintendent's district, and a final summary of the figures of each general superintendent's division gives the grand result for the entire Canadian Pacific system, form S.O.53. Having the figures of work performed, it is a comparatively easy matter to arrive at the cost per ton-mile for hauling. The wages of enginemen and trainmen are compiled in the office of the superintendent for each district for which train records are compiled; likewise the amount of train supplies, while the oil and waste, as before explained, is compiled from the storekeeper's statements of the issues sent in to the statistical office. The fuel is already compiled as to quantity, and all that is needed is the price per ton to arrive at its total value. By dividing the freight and equivalent gross ton-mileage into the total cost of each item, we get the resulting average cost per ton-mile for "freight" or "equivalent gross" (form S.O.52). This average cost furnishes a very fair basis for determining the profitableness or otherwise of any special trains, or any special class of business, on any section or division of the road, when set off against the revenue derived from such business. The results of train operations and car performance summarized on form S.O.53 comprise all information necessary for a complete and intelligent survey of the entire field of train performance, with this qualification, that the value of item "per cent of empty to loaded cars" is impaired owing to the fact that all classes of cars

in freight service are comprehended under the general caption "freight cars." It frequently happens that empty flat cars are being hauled eastbound on the same section at the same time as box cars are being hauled westbound, and the statement gives the appearance of cross-hauling or bad railroading, which would be avoided were the movements of the various classes of freight cars kept separate. The great difficulty in the way of working up such a record, as undoubtedly should be done, is one of expense, although it is quite possible, with the introduction of the Hollerith system of tabulating, that this desirable record may be obtained in an easy and cheap manner.

This question of expense is the serious one to a railroad management. Statistics cost money, and some statistics are dear at any price, but what is worth doing is worth doing well; and well-devised statistics should without question become to the railroad company using them a source of profit. The return on the investment cannot be stated in dollars and cents, but it can be stated without peradventure that the company, whose officials are best posted in the details of operation, is the company which supplies its officials with the best possible analysis of work accomplished. It may be further stated that the official who studies such analysis, and is guided thereby, must inevitably lead the way on the division or railroad where he is employed.

Finally, there is this to be borne in mind about statistics. We want to know when we have a sufficiency of them. A man may eat a big meal, and enjoy it, but he sometimes suffers for it afterwards. Do not overdo the statistical food — it may react. I believe in getting at the root of a matter, and in putting statistics in as simple a form as possible, and making them as just as possible to all concerned. I remember the question coming up in reference to the fuel performance on a certain division, there being a very large increase in consumption per 1,000 ton-miles over the whole division. The figures certainly looked very bad, but on analyzing them it was found that on every district there was a decrease. It was found that traffic conditions had altered to such an extent on two expensive sections as to cause an increase in fuel consumption per 1,000 ton-miles for the division as a

whole. I can assure you this discovery made me careful when criticizing results as shown in statistics and impressed upon me the necessity of getting down to details.

IX. Costs and Results[1]

By William J. Cunningham

The railroads of the United States, on their 245,000 miles of line, transport daily 2,750,000 passengers in trains which run 1,500,000 miles per day. They also move daily 5,000,000 tons of freight in trains which make a mileage of 1,750,000. For this service they collect $7,700,000 per day, and pay out for operating expenses $5,300,000. Of this amount, $3,200,000 is paid in wages to 1,750,000 employees.

With the knowledge of the disbursement of such large sums for operating expenses, it is natural to inquire whether the railroads have adequate checks to prevent leakage and waste, and whether in their analysis of the operating results they are as thoroughgoing and progressive as, for instance, large industrial concerns. In other words, have the railroads established any definite measures by which they may determine the efficiency of the many operating elements which together produce the intangible product of transportation? It is the purpose of this article to furnish a partial answer by describing some methods employed to watch operating expenses, and to suggest further steps which they may advantageously take.

The principles and nearly all of the details of railway accounting are prescribed by the Interstate Commerce Commission. By law the railroads are required to follow the instructions of the Commission as to when, how, and what they shall report. The official classification of expenses calls for 116 primary accounts. The Commission directs specifically how to account for the traffic moved and the work done (in engine, train, and car miles) in moving it. It prescribes how the balance sheet shall be made up, and classifies expenditures chargeable to capital account. The result is that the monthly and yearly returns of the Commission

[1] *System*, October, 1912, pp. 384–391. Reprinted by permission of *System*. Illustrations of charts are omitted.

show comparable and fairly complete statistics of the volume and nature of the traffic, the average rates charged, the mileage made by trains and rolling stock, and the costs of operation.

The returns for expenses, however, are not so complete as the other figures, nor are they comparable between different railroads or different sections of the country because of striking differences in the division of traffic between passenger and freight, and differences in physical and operating conditions. The railroads have been left largely to their own initiative and resourcefulness, therefore, in developing a system for checking costs and utilizing their facilities and equipment.

The operating expenses of the railways of the United States for the fiscal year ending June 30, 1911, were as follows: —

Classification	Total Expenses	Per Cent Expenses	Per Cent Revenue
Maintenance of Way	$369,581,610	19.1	13.1
Maintenance of Equipment	431,892,653	22.3	15.3
Traffic	59,344,441	3.1	2.1
Transportation	1,000,603,053	51.7	35.5
General	74,046,630	3.8	2.6
Total, including $43,193 unclassified expenses	$1,935,511,581	100.0	68.6

The first classification includes the expenses of maintaining the roadway, track, signals, buildings and other structures in proper condition for the safe and otherwise satisfactory movement of trains. The second embraces the costs of maintaining locomotives, cars, and other rolling stock in serviceable condition. The third is the sum spent for the organization for securing traffic — outside agencies, advertising, fast freight-line bureaus, and so on. The fourth, the most important, takes in all expenses connected with the movement of trains. The last division includes the general administrative expenses.

The general manager of a railroad is vitally interested in every phase of operation, but he is primarily charged with responsibility for the safe and economical movement of traffic, which includes the maintenance of way, structures and equipment. It is important, therefore, that he be kept fully and currently informed not only by the ordinary statistical returns prescribed by the Interstate Commerce Commission, but also by definite

measures of operating efficiency — statistics which take account of the differences of the character of traffic and equipment.

This article will deal chiefly with some of the statistical returns which do not appear in the published reports, and by which the supervising officers check the efficiency of the several departments and divisions. The description is necessarily quite incomplete, and will deal only with station, yard, train and engine service. These constitute about 60 per cent of the transportation group of expenses.

The description of modern methods of controlling expenditures through statistics will be clearer if illustrated by a few graphic charts selected from a set compiled by one railroad in eastern territory. The charts are prepared on thin paper so that blue prints may be made, and regularly each month as they are brought up to date, copies are furnished to the general and division officials. It has been found that the charts arouse a greater interest in the returns and inspire keen rivalry between departments and divisions in their effort to excel.

Generally speaking, graphic charts are not common in railway practice, but they are coming more and more into favor and their use is being extended. Occasionally we find a railroad official who is prejudiced against them. He is inclined to regard them as unnecessary and as a reflection upon his ability to interpret the figures. But, fortunately, he is not typical, and his number is decreasing. The majority realize that the charts are more effective in their indication than the figures alone. The curves give instantaneous impressions. They make it possible for the mind to take in quickly a long series of related facts, and both the actual and relative changes in each when compared with the others and with different periods. Briefly, they give the maximum of information with the minimum of mental effort, and they are replete with corrective suggestion. [Chart I. Operating of Coaling Station. Curves plotted monthly for Total Cost of Operation, Average Tons Hauled per Day, Average Engines Coaled per Day, Average Cost per Ton of Coal Handled.]

For instance, Chart II gives a bird's-eye view of the operation of a freight station employing sixty or seventy men and hand-

ling from one thousand to sixteen hundred tons of freight daily. [Curves plotted monthly for Total Tonnage, Track Freight, House Freight, Total Payroll Expense, House Freight Payroll, Track Freight Payroll, Cost per Ton-House-Freight, Cost per Ton-Track-Freight. With such a "graph" as this the monthly changes in the cost of operating a freight station can be followed and compared with the outlay and results for preceding months and years.] The freight is of two classes: (1) that which is handled through the freight house (commonly known as warehouse freight); and (2) that which is handled in carload lots and loaded and unloaded by consignor or consignee on bulk-delivery tracks. The second class is known as track freight. At large stations it is customary for the agent to have each morning a memorandum statement showing the payroll expense of the previous day, the tonnage handled, and the cost per ton. For every station, a monthly statement is prepared and "graphed," with a final graph summarizing the totals and general averages for all freight stations.

In computing the cost of house freight some roads include only the expense of the house foremen and their clerks, checkers, and laborers; others charge to the house its tonnage proportion of the payroll expense of the agent and his main office force. In the chart under discussion the latter method is employed. It will be noted that the cost of handling a ton of freight through this house varies from eighteen to twenty-three cents. It is highest during the winter months when the volume of traffic and the efficiency of labor are lowest.

Chart III summarizes the facts in the operation of a yard where freight trains are classified. [Curves plotted monthly for Cars Handled, Wages, Cost of Wages per Car-Handled, Cars Handled per Engine-Hour. Under normal conditions this chart would show danger signals to any executive after July, 1909. The startling payroll advance and increase in labor and engine costs per car were due to extensive alterations in the terminal itself.] The cost per car handled varies widely in different yards on account of the differences in facilities and the extent of the classification made necessary by the character of traffic

and the location of the yard with respect to other divisions, junctions, and connecting roads. The usual method of determining "cars handled" is to count (1) cars into the yard in trains, (2) cars out of the yard in trains, (3) cars delivered to or received from connecting roads, and (4) cars delivered to or received from industrial side-tracks.

Internal movements within the yard, that is, switching from one yard track to another, are disregarded, because in the first place they are difficult to compute, and in the second place they would swell the divisor and tend to reduce the average cost when extra switching is done which might be avoided by superior yard management. The yard-master plans to classify trains with the minimum number of movements of engines and cars, and if internal movements were included in figuring the cost per car there would be no incentive to reduce them. Consequently, it is not always fair to compare the showing of two yards unless their operating conditions are identical.

The value of the statistics lies in comparing the current record of each yard with its record in previous months or previous years. Each yard is charted separately, but for the information of the officials one chart is prepared showing the results comparatively for all yards.

Every official has his own way of supervising train service, but there are three fundamental inquiries always in mind: (1) is the cost of wages, fuel and repairs justified by the train miles and the tonnage moved; (2) is the capacity of locomotives and cars utilized; and (3) is the service expeditious and otherwise satisfactory? No system of statistics will take the place of personal supervision on the road, but the work of those in authority is made very much easier when they are furnished with complete and current data which reflects the degree of perfection in each of these three fundamental points.

The cost of wages is affected by the method of assigning the crews, train dispatching, the condition of the locomotives, and the care with which trains are loaded to their tonnage ratings. If trains are dispatched with less than their rated tonnage it results in more trains on the road and more train crews under pay.

If trains are overloaded, they are slow in moving over the division, and the overtime paid to the crews usually offsets the saving caused by a reduction in the number of trains. Overloading also affects the service adversely by causing delay to freight, thus inviting criticism and complaint.

The cost of fuel per engine-mile is influenced by the design and weight of the engine, the price and quality of the fuel, the weight of the train and its speed and freedom from delay, and what is most important, the degree of competent supervision and instruction in economical methods of firing. The cost of engine repairs is affected by the same factors and also by the adequacy of the facilities for repair work, particularly in engine houses where running repairs are made between trips and until the engine has reached the condition which calls for general repairs in the larger shops.

A daily freight-train report, showing each train separately, is a prerequisite of intelligent supervision. Without it, the supervising officials work at an extreme disadvantage. It is true that many roads, perhaps the majority, get along without it, but it is false economy. It may be necessary only to compile the complete data for trains moving over the ruling grades, or, where traffic is unevenly balanced, it will serve the purpose to analyze the movement only in the direction of the heavy traffic.

Chart IV contains a mine of information, showing, as it does, the interplay of so many factors. [Curves plotted monthly for Gross Tonnage per Engine-Mile — Eastward, Net Tonnage per Engine-Mile — Eastward and Westward, Freight-Car-Miles per Freight-Train-Mile, Cost of Wages per Freight-Train-Mile, Cost of Wages per Freight-Car-Mile, Average Miles per Freight-Car per Day. The essential freight-traffic history of one railroad division is here shown for three full years in such form that any executive can compare the factors entering into costs and performances of any two months or years of that period.] The first curve shows the gross tonnage of car and content per engine-mile in the direction of heavy traffic. The second curve shows the net tonnage of paying freight per engine-mile in both directions. The net tonnage depends somewhat on the nature of the

traffic. When coal and other "dead" freight runs heavy, it will increase the net train load; on the other hand, if it decreases, or if merchandise and other high-class freight increases in volume, it will tend to decrease the net tonnage per train. Another chart, not reproduced here, shows the division of the tonnage, and serves to interpret other related charts. Still another chart shows the average lading in each loaded freight car and the percentage of empty-car mileage.

The establishment of a system of tonnage ratings and the daily statistical exhibit for individual freight trains is said to have increased the gross train tonnage on this road from 800 to 1100 tons in the direction of heavy traffic, and decreased the number of trains 30 per cent. The reduction in train mileage is estimated to have saved about $500,000 per year.

As another index to train-performance, the third curve on Chart IV shows what was accomplished in freight cars hauled per freight-train-mile. The fourth and fifth curves show the wages cost per train-mile and per car-mile and reflect the increases in the wages of conductor and trainmen in April, 1910. The sixth curve is an indication of the efficiency of equipment, "average miles per car per day."

Chart V gives important information relating to the regularity of service. [Curves plotted monthly for Per Cent Passenger Trains on Time, Average Minutes Late at Destination, Overtime Paid Passenger and Freight-Train Crews, Engine Failures.] Its principal curves are those showing the percentage of passenger trains on time and the average detention of delayed trains at destination. The statistics are compiled from the daily delay reports and includes every minute of train detention. The second and third curves apply both to the passenger and freight service, and are introduced to show the sympathetic relation between engine failures, overtime paid train crews, and passenger-train detention. Chart VI gives an analysis of the causes of passenger-engine failures. [Analysis of Passenger-Engine Failures. Curves plotted monthly for number due to Heating of Boxes and Other Bearings, Steam Failures, Broken Parts, Leaking Tubes and Fire Boxes; also for Average Miles per Engine-Failure, Average

Passenger-Train Detention per Passenger-Engine-Failure. With graphic records like this for all his divisions, accurate and easy comparisons of the efficiency of division executives, organizations and train crews can be made not only by the general management but by the men responsible for the records.]

The elements in the cost per engine-mile are shown in Chart VII. [Cost of Fuel, Repairs, etc., per Engine-Mile. Curves plotted monthly for Supplies, Fuel, Repairs, Engine-house Expense, and Total. The seasonal character of the railroad business is clearly shown by this "graph" covering the cost of fuel, repairs, supplies and engine-house expenses per engine-mile. This is only one of a score of detail charts analyzing operating expenses.]

It is impossible in any one article to cover adequately the whole field of railway operating statistics. The few specific details which have been given are suggestive only and indicate what some of the railroads are doing. On other phases of operation, similar records and checks are established, and constant progress is being made in enlarging and improving upon statistical methods.

In conclusion, it is proper to state that all the railroads of the country are not as far advanced in this respect as the few roads whose graphic records have been reproduced, and other roads of the same class. In fact, there is a wide gap between the methods of those conspicuously in advance and those of the average road. Much remains to be done on the average road in bringing the officials to a realization of the need of a comprehensive system of statistical checks as an aid to intelligent administration. Statistics in themselves will accomplish little, but when carefully prepared, intelligently used, and supported by those in authority, they are found indispensable in modern railroading.

What the railroads need is the establishment of a committee or bureau as a part of the American Railway Association to act as a clearing house for ideas and to set up statistical standards. The Association had such a committee until two years ago, but it made little progress, although early in its existence its work bore promise of fruitful results.

The railroads are publicly charged with having very meagre information on costs, and many railroads must admit that the charge is true in its application to their properties. It is not improbable that the Interstate Commerce Commission will some time undertake to bring about what the Committee on Statistical Inquiry of the American Railway Association failed to accomplish, and it would be much better for the railroads to do it themselves through a bureau of statistics than to have standards forced upon them by the government. By establishing their own bureau of explosives and formulating standard rules for handling this dangerous class of freight, they made it unnecessary for the Commission to prepare such rules. The Commission accepted the railroad standards and gave them the force of law.

Through the American Railway Association the standard code of train rules has practically standardized train operation. The Association has also promulgated car service, per diem, and demurrage rules which are standard. The requirements — physical and educational — of applicants for employment or promotion in train service have been standardized, and in many other respects the railroad associations have brought about uniform action and practice in many operating and maintenance features. But they have not undertaken to standardize statistical methods for deriving unit costs.

Constructive action of this nature is needed, and the sooner such a bureau is established and does for statistical methods what the standard code has done for train rules, the less is the probability of having reform come from the outside.

X. Vitalized Statistics [1]

By James Peabody

Railroad statistics fall naturally under two principal divisions: the one relating to traffic, and the other to operation. So diverse are these, as to both their source and their application, that they are almost wholly unrelated to each other. The more complex, as well as perhaps the more important, of these two branches is

[1] Ernest R. Dewsnup, editor, *Railway Organization and Working*, pp. 369–383. Reprinted by permission of University of Chicago Press.

that of traffic, although hitherto it has received the less statistical attention. We have spent a great deal of time and money in the analysis of our operating expenses, but we have done very little of that work in connection with our earnings. To be successful, the modern merchant must know exactly what he is making or losing on each class of merchandise handled by him; but until recently there were no railroads — and even now there are very few — that have any accurate idea as to the results of handling any particular traffic. If only the volume of earnings during the present year showed an increase over the corresponding period of the previous year, the result was considered as reflecting credit on the department and was therefore satisfactory. In former days net revenue was not the concern of the Traffic Department. Gross earnings was the shibboleth of the traffic official; and little wonder, for he was neither charged with the responsibility, nor had he any means of knowing or controlling the profitable relations of receipts and expenditures. It is only within the past two or three years that objection was made by the railroads to the request of the Interstate Commerce Commission for the furnishing of commodity statistics, on the ground that the cost of preparing such data was so excessive as to make it impracticable. This, although erroneous so far as any necessary expenditure is concerned, affords perhaps the actual, although by no means an adequate, reason why this important branch of railroading should have been so long neglected.

The more progressive of our railroad managers are beginning to see the error of this view, and to realize that information which will enable the Traffic Department to earn an additional dollar is just as valuable as that which shows the Operating Department how to save one. The problem is how this can best be accomplished. The origin of traffic is so widespread, the volume of traffic is so large, and the conditions of traffic are so diverse as to make it manifestly impossible for any general statement to be made, within comprehensible limits, which will afford the directing head of that department the information he needs; and yet it is absolutely essential that he shall have at hand, or within easy reach, whatever it may be necessary for him to know respecting

his business. While it is the grand total that he views with chief concern, it is not with the mass that he deals. What may be designated the units of traffic are the things which command his immediate attention, and it is concerning such of these as are of present moment that he needs to be advised. The problem, therefore, is not so much that of accumulation as of segregation; not the gathering together of the millions of transactions which enter into the handling of traffic, but the keeping of them apart, so that, when called for in any form, the necessary combination can be readily made.

Each separate shipment on a railroad is carried on a waybill, and an abstract is made which recites the essential facts of these waybills, embracing the total of the daily or weekly business of every station on both the forwarded and received side. On the road with which I am connected these abstracts are, by the carbon process, made in duplicate, and a copy is sent by every station to the Statistical Department, thereby giving to it the record of all traffic movements. In this department is prepared, from these abstracts, what is known as a " monthly commodity unit," which represents in a single item the movement of every separate commodity between any two stations on the line, showing origin, destination, weight, ton-miles, and earnings. The abstracts are then filed in calendar order by stations; the monthly units, after being aggregated in certain general ways, being filed by commodities. We thus have at hand in statistical form not only the information ordinarily wanted, but are prepared to furnish almost immediately upon call any information that may be desired.

One or two actual illustrations may serve to make this plain. A certain large firm in a jobbing town in the West, where competition is keen, made application for a reduction of rates from that point into a defined local territory to which, from that point, the existing tariff was prohibitive, and which was therefore supplied from elsewhere. The compensation offered, in event the desired rates were made, was to give to the road from which the concession was asked all the incoming business, which was then being divided among several roads. The problem thus

presented was: Will the additional revenue to be derived from the incoming traffic which the road will then get more than offset the loss caused by the reduction in revenue on the traffic it is now getting? This involved the consideration of a large volume of traffic, moving from many points, at higher rates than would apply if the demand were supplied from the new point of distribution. The Statistical Department was called upon, and, having at hand the information, easily prepared a statement which effectually disposed of the proposition, it being shown that the effect would be not only to reduce the revenues of the railroad, but also to increase the cost to the consumer.

In another case a stock-raiser wished to make a large immediate movement of a certain commodity, which, because of the long- and short-haul clause of the law, would interfere with existing rates on the same commodity to intermediate points. It was necessary to know at once to what extent revenues would be affected, if the required rate were made. The Statistical Department, through its unit system, was able to give the information in three hours which, under the ordinary method of obtaining such data, would have required three weeks, with the result that a profitable business, which would otherwise have been lost, was secured.

Again, arrangements are being constantly made by the Traffic Department covering large movements of freight; but it frequently happens that shippers for various reasons divert their shipments before the specified amount has moved. It is the business of the Statistical Department to keep watch of such traffic, which is easily done through the medium of the monthly units of the commodity movements. It is also frequently necessary for the Traffic Department to know the extent of the business of particular shippers; this the Statistical Department furnishes on short notice, through the use of the abstracts which are so filed as to have the record all together. The number of these calls are so great, and their nature so diverse, as to render impossible any compilation in advance which will serve the purpose; but it is found that, through the medium of the commodity units on the one hand, and the segregated abstracts on the other,

almost any question regarding the movement of traffic is easily and quickly answered.

It is also valuable to know just what each different class of traffic earns. There is widespread ignorance in this regard, and no little injustice has been done to railroads because of it. In the early days of railroading some man conceived the idea of working out the average earnings per ton-mile — a factor not only useless as conveying any information, but absolutely harmful because of the wrong impression thereby created. During the past twenty years, which embraces the period of governmental railroad regulation, this average ton-mile rate has done yeoman service in the reduction of railway charges. No less an authority than the Interstate Commerce Commission employed it in an opinion wherein a rate prescribed by it was held to be certainly justified, for the reason that it was more than double that of the average rate per ton-mile received by the same road as shown in its annual report, although, as a matter of fact, it was, from any transportation standpoint, altogether below the standard of reasonable compensation. While, therefore, the statement of average earnings per ton-mile may be positively declared to be not only useless, but harmful, a report of the actual earnings per ton-mile on each separate commodity is a positive benefit. This, when taken in connection with the average distance each commodity is hauled, the average loading of each commodity per car, and the total ton-miles of each commodity moved, furnishes the traffic man with a comprehensive basis on which to formulate his plans for securing traffic.

It will be observed that no mention has been made of passenger traffic. As already stated, we are using statistics not so much as a record of past events as an indication of future possibilities. So far as I have been able to determine, the results of past passenger traffic furnish no prophecy of future business. That is to say, there is nothing which we can get out of the business already carried which will tell us how to get a single additional passenger in the future. We are required by law to furnish certain information to both the state and the national authorities concerning the movement of passengers, and our figures in this connection go far

enough only to meet this requirement. Occasionally information is desired by our officials regarding a certain movement; but that is easily furnished from the data we keep for the purposes already referred to, and requires no special treatment.

Operating statistics deal with an entirely different proposition; they relate to expenditure and performance. The problem which confronts that department of railroad is to handle the business with the greatest practicable facility at the lowest possible cost consistent with economical results. This is a very different proposition from that which confronts the Traffic Department. There transportation is dealt with on the basis of its entire movement from origin to destination. Here consideration is taken of each separate movement en route. Also, the Traffic Department is concerned only with such tonnage as produces revenue, while the Operating Department must take account of all the tonnage moved, which includes not only revenue freight, but what is known as company freight, together with the weight of the cars in which the commodities are transported.

To illustrate: On a dozen shipments from Chicago to San Francisco the Traffic Department takes account of the rate-paying qualifications of each of the articles transported and deals with them, separately as to each commodity, but, for the entire distance, as a single item. This is because of the different rates charged on the various commodities. The Operating Department, however, consolidates all of these shipments into a single item and reduces them, together with the cars in which they are carried, to one common factor. It then takes account by record of each movement; and there are as many items to be considered as there are engines hauling the freight, conductors in charge of it, operating divisions of the road over which it passes, and subdivisions into districts of main line and branches. It is readily apparent, therefore, that two entirely different theories of statistics must obtain in the treatment of problems which are so diverse. And just here is the explanation why railroad statistics, as ordinarily compiled, are wholly inadequate for any purpose. It is manifestly impossible to make the data necessary for the intelligent comprehension of the operation of either one depart-

ment apply to the other; for, so far as the character of the information required is concerned, there is little in common.

It may be well here to point out a serious, as well as a very costly, error which has crept into railroading because of the misuse of inadequate statistics. Those of us who have been connected with, or have studied, railroad operation have heard of late years a good deal of the "operating ratio," which means the proportion of the total receipts of the road paid out for what are known as operating expenses. Men have been employed at high salaries to take charge of operations, because the statistics of the road on which they were previously engaged showed a small operating ratio. No more misleading, as well as unfortunate, idea was ever conceived than that the operating ratio expresses the measure of transporting efficiency. The final test of all railroad operation is the balance sheet, and it is very possible for a railroad with an operating ratio of 75 per cent, which is not considered commendable, to show a larger balance than would have been the case had its operating ratio been reduced to 60 per cent, which is thought creditable; although, in the first instance, Wall Street would stand aghast, and, in the second, owners of other properties would indulge in a race to see which could secure the services of the man who had succeeded in reducing his ratio to such a supposedly favorable basis.

To measure the capacity of a transportation official by the operating ratio can easily be shown to be both illogical and unfair. One of the principal factors in the determination of this ratio is gross earnings — something with which the man in charge of operation nowadays has nothing whatever to do. Another important factor is made up of what is known as operating expenses, one of the main items of which is maintenance of way. The amount to be expended on this account each year is determined, not by the transportation official — although he is consulted — but by the Board of Directors, or at least by the Executive Committee, and the official is expected to use the designated amount to the best advantage. Still another important item is maintenance of equipment, and here too the amount is largely determined in the same way; for maintenance includes not only

repairs, but also renewals. The general expenses — under which term are included the salaries of the general officers together with their office expenses, and also insurance and the law — are also matters wholly beyond the purview of the transportation official. Thus we have left only those expenditures which come under the head of conducting transportation, over which he has immediate control; and of these a very large proportion are beyond his ken. Such items as superintendence of traffic, advertising, outside agencies, commissions, and to some extent car mileage and loss and damage, amounting perhaps to from 10 to 15 per cent of the total outlay under this head, are not within his province. It is perfectly plain, therefore, that to make the operating ratio the measure of an official's capacity is doing him an injustice on the one hand, or giving him undue credit on the other. As constituting a standard, it is altogether valueless.

Not only is this the case, but it operates to injure railroad revenues. Any man worth having on a railroad is striving all the while to improve his position, and he will naturally shape his conduct to meet the requirements of promotion. So long as the operating ratio is the standard, regard for his advancement demands that every engine when moved shall always be loaded to its full capacity, and that such capacity shall consist, as far as possible, of loaded cars. Traffic, on the other hand, frequently requires rapid handling, and very often large movement, of empty cars at short notice, in order that business which would otherwise be lost may be secured. It is easy to see that just here is projected a conflict. Lightly loaded trains and fast movement, or the hauling of empty cars under quick orders and for long distances, means an increased operating ratio; and although the result of such movement may serve to increase the net balance at the end of the year, the man's reputation suffers. The trouble is that the revenue which is lost because of failure to perform a service which unfavorably affects the operating ratio does not in any way appear in the accounts. If such lost revenue could be charged up as an item of expense, there would be a very great change in the method of operation on many roads. This is one of the problems which it is the duty of the Statistical Department to solve.

For many years there have been divergent views as to the best unit to employ in this department for purposes of comparison. The commercial ton-mile, which includes only revenue freight; the net ton-mile, which embraces all freight both commercial and company; the gross ton-mile, which includes the weight of both the car and contents; the car-mile, which considers each individual car as a unit; and the train-mile, which treats as a single item the entire number of cars in each train, have all had their advocates. While it is conceded that no one of them constitutes a perfect unit, it is now generally admitted that the gross ton-mile forms the nearest approach to it.

Selecting, then, the gross ton-mile as the unit of work performed, it is necessary to provide a correlative unit as the measure of the performance of the work. Here, again, variant views are held, and we have the engine-mile, which is the unit of miles run per locomotive; the tractive force, which expresses the theoretical hauling power of the locomotive; and the traction ton-mile, which is the weight on the locomotive drivers multiplied by the miles run. The first, because of the varying size of the locomotives, is manifestly incompetent; the second, because of the extreme divergence of views as to the factors to be considered in its determination, is of little value; leaving the third, which, although indefinite as to the amount, is, nevertheless, absolutely comparative as to performance, and therefore the best unit thus far ascertained. Using these two units — to wit, the gross ton-mile as the measure of the work performed and the traction ton-mile as the measure of the force performing it — we have the ratio of both efficiency and economy. If we can increase our gross ton-miles per traction ton-mile, we are adding to our efficiency; if we can do it at less cost, we are progressing in economy.

The most convenient means for obtaining the record of gross ton-miles is from what is technically known as the "conductor's wheel report." This furnishes all the necessary data required for keeping account of car movement, train movement, gross ton movement, and net ton movement, all of which enter into the statistical result. In connection with these movements are kept

the records of wages of the train crew, amount of fuel consumed, and other items entering into the train expenses; so that it is easy to determine the work performed by each unit of power, and the relative direct cost of doing it. Into this computation also come the repairs of each locomotive, making it possible to determine in a general way the type of engine best fitted for a given service. In order to encourage fuel economy in the running of locomotives, an individual record is kept of the gross ton-miles hauled per ton of coal used by each engineer, this being posted at the end of each month for comparison and inspection.

In addition to the methods already enumerated, all expenditures on account of operation are summarized under four general heads, namely: maintenance of way, maintenance of equipment, conducting transportation, and general expenses; which are in turn analyzed and subdivided under fifty-three designations. This distribution is first made as to location — that is to say, the particular part of the line upon which each expenditure is made. Those outlays which, by reason of their general character — such as superintendence, repairs of equipment, etc. — cannot be definitely assigned as to location, are apportioned on the basis of car-mileage or locomotive-mileage on each portion of the road, as may be most appropriate. This distribution is made, not only by divisions of the road, but by main line and branches, so that each portion of the road bears its own proper burden. Having thus ascertained the amounts chargeable against each portion of the road, they are again subdivided as between freight and passenger service on a basis of train-mileage. Against this final subdivision is put the number of engine-miles, car-miles, ton-miles both gross and net, and train-miles, permitting us to compare, in each particular, the work of one month with that of another on each division of the road, as well as on the entire system. By this means is shown the average cost of operation on each separate portion of the road.

It will be readily understood that, having on the one hand the average cost of transportation by divisions, and on the other the actual revenue earned by commodities, we are able to determine, not what it costs us to haul each separate commodity, but

whether we are receiving, on any particular commodity, the average cost of transportation over the particular portion of the road on which it moves. I think it will not be disputed that any equitable adjustment of transportation charges should assign to each principal article of commerce a rate which will at least pay the average cost of transportation; otherwise some commodity is compelled to bear a burden which properly belongs to another.

The value of statistics of this character was recently demonstrated in what is known as the Texas Cattle-Raisers' Case, in which complaint was made to the Interstate Commerce Commission that the rates on cattle from Texas to the markets were too high. To disprove this statement, the movement of a car of cattle was followed from representative points in each of forty-two rate groups in Texas and Indian Territory, both to Kansas City and to Chicago. The average cost of movement over each separate division traveled was computed on the gross ton-mile basis, and it was found that the actual revenue received for such haul averaged nearly $8 per car less than the average cost to Kansas City, and $19.52 per car less than the average cost to Chicago. It was thus conclusively shown, not only that the rates were not too high, but that they were still too low, and that the recent advance of which complaint was made was more than justified.

XI. Statistical Units Used in Analysis of Electric Railway Accounts [1]

By James A. Emery

In preface I wish to make a plea that operating men give more attention to the forms of accounts. The president and directors of a company are concerned with the summarized figures of the income account but the details of revenue and expenses are prepared for the information of the manager. He should therefore prescribe that they give him what he needs to know. Here, from the manager's standpoint, lies a failing of our accounting system — that our classification is based on the character of the expendi-

[1] *Proceedings of the American Electric Railway Accountants' Association*, 1913, pp. 152–161. Reprinted by permission of American Electric Railway Association.

ture rather than the object for which the expenditure is made. It seems the height of absurdity, for example, in the electric light and power business, to draw careful distinctions between the elements of demand and output in making rates and then to pay absolutely no attention to this distinction in the records of cost of service. To determine or check the important figures upon which the charges to customers are based, it is necessary to go through a painful process of analyzing expense and construction accounts. There is no reason why central station expense accounts should not be kept in such a way that we may know every month the cost of maintaining a kilowatt-capacity in readiness to serve, of the additional cost of generating and distributing one kilowatt-hour, and of the cost per customer of those operating expenses, which vary directly as the number of customers.

In street railway accounts, likewise, there is much opportunity for improvement. We spend millions of dollars per year for special work and yet few managers can tell how much it costs them, as the labor cost is not segregated. Our standard system of accounts does not provide means of ascertaining the costs of the important items of painting cars or of repairs to trucks or of repairs to air brake equipment. In setting up depreciation or renewal reserve accounts we do not specify and allow for parts to be replaced under maintenance. We lump in one account all payments for damages and have no way of telling directly how much is paid to passengers and how much to the general public or employees; how much is paid in settlements and how much in judgments.

These observations are not made in criticism of our accountants who have done so much to systematize our business records and who have been pioneers in analysis, classification and standardization. It is the manager who should now step forward and tell the accountant what he uses the information for, how he uses it, and in what forms he needs it. This brings us to the question which has been discussed before: What is the purpose of accounts?

We keep accounts to make sure that we do not lose or waste money. We reduce accounts to a unit basis to determine effi-

ciency. A certain amount per unit of product or service is received and we endeavor to earn this amount as cheaply as possible, consistent with producing a satisfactory product or service. We therefore analyze, classify and examine our various expense items to determine where we may cheapen any of them per unit of finished product. The ultimate aim is to reduce the ratio of cost to receipts, and in working to this end we try to produce in our accounts microscopic details, as clear and undistorted as possible. We then try to establish and work to standards based on what has been done on other properties and in other years.

The ratio of cost to receipts is misleading when used for comparison in city transportation because, unfortunately, the revenue is not proportioned to the service rendered. If we eliminate the factor of rate of fare and calculate costs per passenger, we can deduce standards based upon differing lengths of haul, density of traffic and load factor, but service required and rendered is not even proportional to the number of passengers thus qualified. A street railway must provide: —

1. During the rush hours, a number of passenger space-miles (seats and standing spaces).

2. During the between-rush hours, a number of seat-miles; or on smaller properties, car-miles.

3. During the night and early morning hours, a number of car-miles to maintain reasonable headways, with little regard to the volume of traffic.

Therefore, a system would show high efficiency of design and operation when the cost per space-mile during the rush hours and when the cost per seat-mile during the between-rush hours is low, and when the cost per car-mile during the night and early morning is low. It is manifestly out of the question to apportion costs on the above basis and our problem is to determine the practicable basis which comes closest to it. That is, we would like to find a unit which when divided into our costs will tell us, without substantial qualification, if the operation of a property is efficient and if the engineering design and construction are good.

The various units commonly considered, in the order of their relation to each other, are: —

1. Dollars (per cent) of gross earnings.

2. Revenue-passengers. Equalling gross earnings divided by the average rate of fare.

3. Passenger-miles. Derived from the number of passengers multiplied by the average haul.

4. Seat-miles or space-miles. Proportioned to the passenger-mileage and also dependent upon the density of traffic.

5. Car-miles. Equalling the seat-miles or space-miles divided by the seats or spaces per car.

6. Ton-miles. Equalling the car-miles, multiplied by the average weight per car or the seat-miles multiplied by the average weight per seat.

7. Car-hours. Equalling the car-miles divided by the average speed.

8. Normal-maximum-cars in operation. Derived from the car-hours and the service factor.

9. Car-trips. (Round trips.)

Let us consider in order the relative merits and disadvantages of these units: —

1. *Dollars of gross earnings.* As the money which comes in measures the absolute limit of the total outgo, it is very important that we should know in simplest terms what proportion of it goes to each item of expenditure. Percentage of gross earnings should therefore be used, whatever units of service are chosen. In comparing one property with another on this basis, however, care should be taken to see that the average rate of fare, average haul, density of traffic per mile of track and load factor are not widely different.

2. *Revenue-passenger.* The use of this unit would eliminate the variance due to difference in rates of fare, and the cost at which a company carries a passenger is in general a fair measure of the efficiency of design and operation, if values or factors for the principal fixed conditions of average haul, density and load factor are known.

3. *Passenger-mile.* Presentation of the cost of transporting one passenger one mile would eliminate discrepancies in average length of haul. It is not practicable, however, on a city system

to calculate passenger-mileage regularly and it must be remembered that service cannot be proportioned exactly to the passenger-mileage.

4. *Seat-mile or space-mile.* In stepping from the passenger-mile to the seat-mile or space-mile, we introduce the first factor dependent upon operating efficiency. A manager, by lack of attention to schedules or traffic, may operate more seat-miles than are necessary. His maintenance of track and line and general expenses which do not vary directly with the seat-mileage will therefore figure lower per seat-mile and his operation on the seat-mileage basis would actually appear efficient when it may be poor. If, however, we can establish standards of proportions of seat-miles to passenger-miles for various traffic densities and load factors, a statement of such proportion, together with the cost of service per seat-mile for a given system, would furnish a practically complete basis for judgment of its efficiency of design and operation. The use of the space-mile is hardly worth considering, for, while it ought to be understood that standing space must enter into rush-hour calculations, its general use would be popularly offensive. Space-mileage is a measure of service for not over 25 per cent of the traffic of the day and the spaces per car vary in a considerable degree as the number of seats.

5. *Car-mile.* Our friend of long standing, the car-mile, is implanted in our imagination and habits of thought and to give it up would involve something of the readjustment which would attend the adoption of the metric system in general business. Car-mile figures are generally in convenient denominations and the unit is the most appropriate for many equipment records. Compared with other units under consideration, the car-mile has the same merits as the seat-mile, but at the present time labors under the serious objection that there is such great variation in the capacity of cars. Although the average car is approaching a standard of from forty to fifty seats, there is always likely to be considerable variation. The car-mile is a measure of about 25 per cent of the service provided by a street railway. Car-mileage can be calculated easily and accurately and it has the advantage of long use and familiarity. As will be seen later, differences in size of

cars and speed may not produce great variance in total operating expenses per car-mile.

6. *Ton-mile.* The ton-mile has some merit as a unit for judging efficiency of operation. A considerable portion of the operating expenses varies directly as the weight moved, but our unit should show efficiency of design as well as operation and the ton-mile sidetracks one of the most important features of design. For example, if for a given property the operating expenses per ton-mile be low, it would appear that the operation is efficient. This might not be the case — for, if unnecessary weight were put into the cars through poor design, the ton-mileage would be abnormally high and the operating expenses per ton-mile abnormally low. Ton-mileage is more difficult to calculate than seat-mileage, on account of the live load.

7. *Car-hour.* When used side by side with the car-mile, the car-hour indicates only the effect of speed. It has some advantage over the car-mile in comparing revenue statistics, for it shows clearly the advantage in higher speeds and furnishes a more accurate, quick basis of comparison of the net earnings of various routes than does the car-mile. For use in analyzing the details of operating costs, however, it is not so accurate a gauge of efficiency as the car-mile. As operating expenses per car-hour are constant multiples of operating expenses per car-mile, it seems wasteful to use them side by side for details. Like the car-mileage, the car-hourage can be calculated easily and accurately. It is not, however, a direct measure of any part of the service.

The relation of the element of speed to revenue and expenses is intricate. It is certainly cheaper to haul a given number of passengers between two points at high speed than at low speed. It, therefore, would seem that at a less cost we can furnish what passengers prefer and would even pay more money for. Why then are our rates on suburban or high-speed lines at least as high as on city lines? The answer is found in the element of density of traffic. We can move 100,000 passengers over a given piece of track very much cheaper per passenger than we can move 10,000. This balancing of factors explains the remarkable uniformity of operating expenses per car-mile on systems widely

different in size and character. It also brings to mind the fact that differences in size of cars may not make great differences in the cost of operation per car-mile for handling the same volume of traffic; for, while most items of operating expenses are greater per car-mile for larger cars, the item of platform wages, with some others, totalling about 50 per cent of the operating expenses, is proportionately smaller.

Speed is governed by all three elements which control the destiny of a street railway. It is in part fixed by physical and legal conditions over which neither construction engineer nor operating manager has control. It is dependent on the design of track, rolling stock, power plant and distribution system. An effort to obtain higher speed in the design would have saved many properties from bankruptcy and the neglect or failure to design for the highest speed practicable has crippled many others. The average number of car-miles per car-hour depends upon schedules, discipline and condition of equipment. Higher speed increases revenue per car-hour and increases expenses per car-hour. It has no effect on revenue per car-mile but it decreases expenses per car-mile. It has no effect on total revenue but it reduces operating expenses. The car-mile, therefore, brings out this important element of operating efficiency more clearly in the operating expenses, while the car-hour has a similar advantage in relation to revenue.

8. *Normal-maximum-cars-operated.* In electric lighting and power supply a large proportion of the cost of production varies directly as the maximum demand. To a less extent this is true in the street railway business. Our loads fluctuate quite as much as do those of central stations, but it is not commercially, or in many cases physically, possible to provide corresponding service. We, therefore, furnish seats during the non-rush hours and passenger spaces during the rush hours. Even with this help our service factor or ratio of average cars to maximum is low and a considerable part of the outgo of a street railway is proportioned to the number of cars that have to be put on the streets during the maximum hour of travel. The car is a convenient and common unit of equipment costs. It is, therefore, of interest and value to

know how much money a car takes in per year and how much its operation costs. This unit, however, does not lend itself to useful analysis of the details of revenue or of many of the operating expenses.

9. *Car-trip.* The car-trip is sometimes used for expressing revenue and expenses in terms which can be easily understood by the public. The compilation of the number of trips is worth while as it leads up to the average length of trip and thus gives an indication of the average length of haul.

10. *Train units.* Train-miles or train-hours have very little utility for electric railway work, as few operating expenses vary with the number of trains operated. Where the motormen on lines operating multiple-units are paid higher rates of wages than the other trainmen there is some difference, but, after all, we are trying to operate car-hours and car-miles cheaply and we do not have much control over the rate of wages — so that if wages of motormen per train-hour are high it simply means that the rate of wages is high and gives no indication of efficiency of operation.

In the writer's opinion, trailers should be treated exactly as motor cars, if they provide the same passenger capacity. By so doing, the economy or lack of economy in using them may be shown.

Reviewing the advantages and disadvantages of the various units, we see that percentage of gross earnings is always a useful basis for the analysis of operating expenses; that the unit revenue-passenger would be satisfactory if proper values could be determined for varying length of haul, density of traffic and load factor; that the passenger-mile is not practicable on account of the approximations necessary in calculating the passenger-mileage; that the seat-mile and car-mile may be completely satisfactory as a basis of comparison if the efficiency of operating schedules can be determined; that the car-hour is useful for comparing revenue; that the ton-mile is not generally useful; and that the normal-maximum-cars applies to a portion only of the operating expenses. If operating schedules be held to a standard of efficiency with relation to the average length of haul per passenger and density of traffic, then these two factors are eliminated and

cost per seat-mile on one property becomes directly comparable with that of another. The seat-mile is a somewhat inconvenient unit for analysis of both revenue and operating expenses, as the values are so small. To use it practically, therefore, we should have to use multiples of possibly 50 or 100. A reasonable method might be to establish a car standard of forty or fifty seats and modify the car-mileage accordingly, producing a unit which might be called "40-seat car-mile." This unit would give a good basis of comparison between properties, not only in total cost per unit but in each of the details. There would probably be objection to such a unit, on the score of cost of compilation. This extra cost, however, could be made slight by the use of tabulated equivalents.

There is no unit, however, which furnishes a completely satisfactory basis for comparison of all items of operating expenses or even of all groups of items. That is to say, the "40-seat car-mile," as applied to track maintenance accounts, shows the maintenance necessary for the passage of one car over a mile of track.

The density of traffic or number of car-miles over each mile of track has a considerable effect on the cost per car-mile. That is, if the car-mileage per mile of track be low, certain fixed expenses will be higher per car-mile. If, on the other hand, the car-mileage per mile of track be high, there will be more wear and tear and certain of the maintenance costs will be higher per car-mile. It is so difficult to judge offhand the opposite effect of these factors on the cost per car-mile that many people who have to consider such matters go back to the fundamental basis of maintenance of track per mile of track. Similarly: —

Maintenance of equipment is properly figured	per car
Power	per kilowatt-hour
Platform wages	per car-hour
Other operation of cars	per car

and general expenses may be usefully treated in the same manner as overhead charges on construction work — that is, as a percentage of all other operating expenses. The important item of damages might better be classed by itself and figured per passenger.

Establishment of Standard Values

If the operating expenses of all companies were regularly analyzed in this manner, it would be possible to establish standard values for each group of accounts, making allowance for the variation caused by lesser differences in conditions. For example, the cost of adequate maintenance of way, track and line per mile of track could be determined for various amounts of car-miles per mile of track. Further refinements might then be made for: —

Percentage of special work.
Percentage of paving.
Average weight of rail.
Average age of rail.

This will eliminate the principal conditions which are fixed naturally or by engineering design and thus may be shown the limits within which the operating manager should work. In the same way, normal cost of maintenance of equipment per normal maximum car operated may be determined for cars of various capacities and for various amounts of car-mileage per car. Reasonable limits for the remaining groups of operating expenses may also be determined for varying conditions. It is suggested that the determination of such standards is a useful field for this Association. It goes without saying that a manager searches every nook and cranny of his expense account to learn where reductions of any kind are possible, but it will always help him if he knows definitely what other people are doing on the same basis and he is often harassed by having details of his property compared unfavorably with others where the conditions are distinctly different.

The reduction of operating expenses to the above units would permit of ready and comparatively accurate computations of the net earnings of various operated routes or lines, where many lines of different length and character are operated under one system. This might be done with profit once, twice, or four times per year.

Such unit computations would have little value when applied to monthly expenses and if used every month should be applied to the operating expenses for the past twelve months.

Units appropriate to smaller groups of accounts, or even to individual accounts, might be used if desired, as, for example, the number of feet of special work applied to the cost of maintenance of special work, or the car-mileage applied to the damages other than passenger.

With any statement or analysis of operating expenses it is absolutely necessary that a statement of operating statistics should be presented, together with all of those statistical relations upon which the details of operating expenses depend. This is seldom or never done in a systematic manner. Such statistics not only are necessary in order to form a correct opinion of operating efficiency but they have features and items which are as valuable as the details of operating expenses themselves.

The suggested unit "normal-maximum-cars-operated" is defined as the average for the four weeks of a month of the maximum number of cars run in regular service on the heaviest day of each week.

The suggested "service factor" is the ratio of the average number of cars to the normal maximum and is derived by dividing the total car-hours by the number of car-hours that would have been made by the normal maximum number of cars operating a full day of twenty-four hours. This factor corresponds to the load factor of a power plant.

There are doubtless other relations of statistical units to each other which would be worth the cost of calculation once a month.

An approximate determination of the passenger-mileage of any line or system is not difficult or expensive. It is a reasonable assumption that the character of traffic on normal days of each season of the year is about the same from day to day and that the character of travel on one car will average the same as that of another. In making such a determination, therefore, it is only necessary to place observers on one car in every six or seven on a given line for an entire day and count the passengers on and off at each stop. The calculation of passenger-mileage is then simple and if done graphically shows other valuable information, such as the point of maximum load, the ratio of number of passengers

carried past the maximum load point to the total carried and the points at which turn-backs should be permissible. This can all be done at a cost of not over $25 per route of average density of traffic.

The compilation of statistics is usually treated either too lightly or too seriously. Many people fail to appreciate the value of an analytical examination of figures and many others prepare great masses of figures and details which, by their volume and lack of correlation, confuse rather than instruct. Analyses of accounts and statistics are worth while if they point the way to saving money or if they present an accurate measure of operating or engineering efficiency. The cost of the clerical work involved, however, must not exceed the money which might be lost if such figures were not prepared, and — with all the power that within us lies — the figures must be accurate. This means not simply that arithmetical details must be correct but that the basis of the figures shall be sound and consistent. There is a deeply rooted prejudice against approximations, but few deductions can be drawn from street railway statistics or accounts without approximations. We should, therefore, study the limits of error and we should not be afraid to make approximations when we know just how much or how little they affect the answer we are seeking.

The recording and presentation of the operating results of a street railway still offer a broad field for investigation and thought.

XII. The Function of Statistics in the Telephone Business [1]

By Walter S. Gifford

It is only quite recently, almost within the last generation, that statistics have begun to play a vital part in the business world. The development of statistics in business is most logical. As business enterprises increased in size and scope they more nearly

[1] Walter S. Gifford, *The Function of Statistics in the Telephone Business*, pp. 5–21. Reprinted by permission of the author. Illustrations of several charts and forms are omitted.

approached, from an administrative standpoint, the characteristics of a state, so that, precisely as governments have for years found statistics necessary for their proper administration, in a similar way the large organized business now finds them quite indispensable. Furthermore, business is becoming more and more of a science, and so we find, as in the case of other sciences, the need for statistical data and methods.

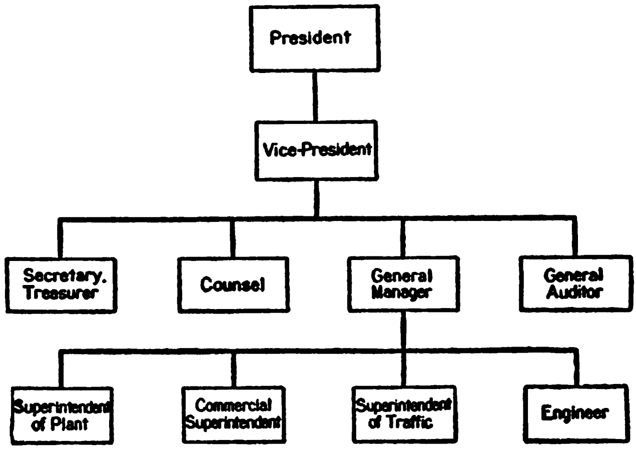
The Bell System is performing a public service throughout the entire United States, and in so doing is employing nearly $1,000,000,000 of property and 200,000 employees. It furnishes telephone service directly and indirectly to over 7½ million telephones located in the homes or business offices of millions of people living in over 70,000 different places. Imagine, if you can, the administration of such a business without statistical data as to what is going on here and there, or as to the comparative efficiency of one method of operation with another, etc. The 75,000 stockholders, to say nothing of the thousands of bondholders, would soon wonder what had become of their investments; the public would find the service demoralized; and the employees would soon be looking for other positions. Just as it is impossible for one man to look at a forest of thousands of trees and remember the height of each, so it would be impossible to manage this telephone business without recorded statistics.

Organization. A brief description of the organization of the Bell Telephone System is necessary to understand clearly what part statistics play therein. To avoid complicated explanations, the organization as described is simplified somewhat from the actual, although it is substantially as shown. The United States is divided for operating and administrative purposes into eight divisions. Each division has its own administrative officers and working forces, and keeps its own accounts. Some of the divisions comprise several operating companies. The American Telephone and Telegraph Company acts in a supervisory capacity in relation to all divisions.

A typical organization of any one of these eight main operating divisions is illustrated by the chart on the next page.

It will be noted that, aside from the general staff, there are three operating superintendents, — Commercial, Plant, and Traffic, — the Commercial busy with canvassing for new business, collecting revenues, determining rates, and in general all publicity and advertising work; the Plant with maintaining plant already built and with the construction of new plant; and the Traffic with the

TYPICAL ORGANIZATION CHART OF AN OPERATING DIVISION



actual operating of the exchanges and toll lines, that is, the furnishing of telephone service. The Engineer is really a staff man on the staff of the General Manager and is not directly in charge of operations.

The statistical problem. Now the officers of the Bell Telephone System have two main points of view from which they must plan their work—one from the standpoint of service rendered the public, the other from the standpoint of the stockholder. In other words, their fundamental problem is to furnish the best possible service at the lowest possible cost and to earn a reasonable return upon the investment. The Board of Directors, the Executive Committee, and the officers responsible for the busi-

ness should know at all times to what extent these two aims are being accomplished. Each employee who holds a position of responsibility should be acquainted with the extent to which he is efficiently contributing toward the accomplishment of these ends. In such a highly organized undertaking as the Bell System, just as in the development of highly organized animal life, specialization of function must take place. This means that all the various specializations must be brought together at the executive office of the business. Statistics make such a centralization possible. Now in each Operating Division, as shown by the typical organization chart, we have a fairly simple three column specialization of function, giving three main subordinate centers, the Commercial, Plant, and Traffic Departments. Each branch, or subordinate center, as well as the head executive office, must know at all times whether or not it is playing its part with the highest possible degree of efficiency.

The business man running his own independent business in a small way will perhaps tell you that he has no use for statistics; he will perhaps say that he carries in his head all the facts that he needs to know; that his business insight enables him to make his judgment accurate and profitable. Of course, what he really does is to rely on memory and personal observation. Unconsciously, then, he uses statistical data and methods in his work, although he does not tabulate them or record them.

Now there is a tendency for a department head in a large organization to feel the same way regarding statistics. There are several reasons, however, why this attitude is fallacious. In the first place a man may be promoted, or transferred, or may resign, and he naturally does not leave behind any information that he has not recorded in reports or tables of some sort. Second, as a matter of fact, he is not able to carry in his head nearly as much information as he may think he can, and to this extent his work is not as efficient as it might be. Third, it is difficult for him, except by personal interview, to prove his efficiency to officials higher up, unless he presents some sort of statistical reports. Fourth, his superior may, without tabulated data, fail to realize any improved methods which the subordinate may have developed

and which would be of value to adopt for similar conditions elsewhere.

A department head is busy, and frequently the compilation of data for his own use, and particularly the complying with outside requests for data, is, on the face of it, very annoying. This explains what is often believed to be an inherent dislike for making out reports. Because he is unable to see, in many cases, how certain data that has been requested can serve any useful purpose, he is inclined to feel that to demand of him the time to get it together is an imposition. Fortunately, this attitude of mind can be cured by education, and in the Bell System we have made marked improvement in this line, so that now it is fairly safe to say that the main department heads at least cheerfully furnish whatever statistical information may be requested, and take keen interest in providing for themselves data which will help them in their specific work.

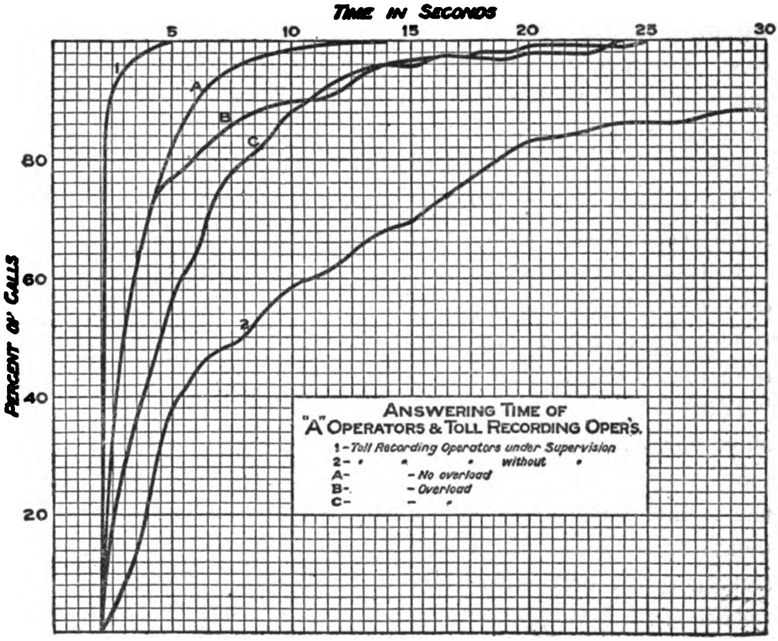
Specific departmental statistics. As an illustration of specific departmental statistics there are shown, following, some of the statistical reports in use in the three main operating departments — Commercial, Plant, and Traffic.

The Commercial Department statistical report shows most important data regarding new subscribers to telephone service, and the total and average amount of new revenues resulting therefrom. [Shows for each Central or Local Office District: — Number of New Stations, Revenue Value of New Stations, Additions other than Stations to Existing Contracts, Net Gain in Revenue, Supersedures, Cancellations, Net Gain, Not Included in Previous Items, Obsolete Contracts, Analysis of Station Gain, with numerous subdivisions under each.]

The statistical report of the Plant Department — "Report of Subscribers' Line Trouble" [shows for each Central Office: — C. O. Trouble per Line, Line Trouble per Line, Station Trouble per Station, Fd. O. K. per Station, Test O. K. per Station, Average Time (C. O., Line, Station), Lines.] In this department certain "trouble units" have been devised to furnish accurate comparative records, so that an unusual amount of trouble may be at once apparent, sought out and remedied.

The Peg Count report prepared by the Traffic Department measures the volume of business handled by the operating forces hourly and is, of course, fundamental to this department. It is of use in determining the amount of apparatus needed, the volume and growth of traffic, and the operating efficiency and cost.

The following diagram shows the results of a special study conducted by the Traffic Department. This is of interest principally



because it shows how statistics may show up a practical condition in a most graphic manner.

Now it is obvious that the statistical data just represented is of assistance in the administration of each department. It is also obvious that, while each report or diagram tells the story for the functional purpose for which it was designed, no one of them quite tells the whole story.

Regular administrative statistics. So far we have concerned ourselves with examples of the use of statistics in the operating

departments. Up to this point it might be said that there is no particular need for a statistician or a department engaged exclusively on statistical work. The results, however, of the work done in these functional departments must be correlated and presented to the executives in such a manner as to be of practical use to them in running the business as a whole. This means, among other things, the correlating of the accounting with the statistical data on operating results. We must know whether we are earning a reasonable return on our investment, as well as whether we are giving a first-class service to the public at a reasonable cost. The furnishing of data to show this is not entirely accounting work, nor is it the duty of any one of the three departments previously mentioned. It appertains to the business as a whole, and is the duty of the Statistical Department.

The table opposite (Monthly Report No. 1) is perhaps our most highly condensed regular statistical report.

In this report are the main items (so far as we have yet developed them) needed by the Executive to form an opinion as to how the business is going to appear in condensed form. The percentage of increase in "Physical Property," in "Telephone Revenue," in "Total Telephone Expenses" and in "Net Telephone Earnings" show how the business is running now as compared with the previous year. The actual figures show how much is being earned this month and to date this year in excess of dividend requirements and whether the Company or Division is earning a reasonable return on the investment. Assuming that these financial results are not all that are wished for, various items under Percentages show in a general way where the trouble is. Near the bottom of the report, the development of the business is brought out by the number of stations and the number per 100 population, thus partly telling the story from the standpoint of the public, inasmuch as an increase in the number of subscribers means directly an increase in the service to the public.

Monthly Report No. 1

COMPANY A

CONDENSED SUMMARY OF REPORTS FOR........1913[1]

ASSETS	LIABILITIES
At end of month, Increase over last month, Increase over Dec. 31, 1912, Per cent over Dec. 31, Increase over same month last year.	
Intangible Capital	Capital Stock
Physical Property	Funded Debt
Investments	Advances from System Corporations
Cash and Deposits	Current Payables
Current Receivables	Deferred Credit Items
Deferred Debit Items	Reserves for Depreciation
Total	Surplus
	Total

EARNINGS AND EXPENSES

This month, Increase over last month, 9 months since Dec. 31, 1912, Increase over same period, 1912, Per cent increase.

Exchange Revenues	Net Telephone Earnings
Toll Revenues	Sundry Net Earnings
Total Telephone Revenue	Total Net Earnings
Operation Expenses	Deduct Interest
Current Maintenance	Balance Net Profits
Depreciation	Deduct Dividends (Paid and Accrued)
Taxes	Undivided Profits
Total Telephone Expenses	
Av. Monthly Tel. Revenue per Station	
Annual Dividend Rate 6%	Total plant per station at end of month, At Dec. 31, 1912

PERCENTAGES (Annual Basis)

This month, Last month, 9 months 1913, 9 months 1912.

Telephone Revenue to Average Plant in Service
Operation Expense to Telephone Revenue
Telephone Expense to Telephone Revenue
Current Maintenance to Average Plant in Service
Depreciation to Average Plant in Service
Net Telephone Earnings to Average Plant in Seivice
Total Net Earnings to Average Capital Obligations
Balance Net Profits to Average Capital Stock

STATIONS

Total at end of month, Per 100 population, Net gain this month, Net gain 9 months since Dec. 31, 1912, Per cent net gain, expected, realized, Per cent stations over same date 1912.

Owned Stations
Connecting Stations (incl. Service and Private Line)
Total

WIRE MILEAGE at end of month

Exchange, Per cent increase over Dec. 31, 1912, Toll, Per cent increase over Dec. 31, 1912, Total, Per cent increase over Dec. 31, 1912, Per cent increase over same date 1912.

Miles of Wire

[1] Only the list of items has been reproduced. [EDITOR.]

Now it is desirable to have a statistical report that will show how efficient different companies or divisions are as compared with each other. The following report is designed with this in view. Practically all general statistical units (both cost and service units) that seem applicable to the telephone business appear on this two-page report. Different divisions have of course different conditions to meet, so that it is not correct to make final judgments of efficiency on the basis of statistical units only. However, if this report is intelligently used, it will aid effectively in locating inefficiency. Moreover, regardless of different conditions to be met, each company or division must, before being regarded as efficient, earn a reasonable return and how near it comes to doing so is brought out by this report.

BELL TELEPHONE SYSTEM IN UNITED STATES

Comparisons by Companies

PERCENTAGES (Annual Basis):

As reported:
Telephone Revenue to Average Plant in Service
Operation Expense to Telephone Revenue
Telephone Expense to Telephone Revenue
Current Maintenance to Average Plant in Service
Depreciation to Average Plant in Service
Net Telephone Earnings to Average Plant in Service
Total Net Earnings to Average Capital Obligations
Balance Net Profits to Average Capital Stock

As Adjusted for Uniform Depreciation:
Telephone Revenue to Average Plant in Service
Operation Expense to Telephone Revenue
Telephone Expense to Telephone Revenue
Current Maintenance to Average Plant in Service
Depreciation to Average Plant in Service
Net Telephone Earnings to Average Plant in Service
Total Net Earnings to Average Capital Obligations
Balance Net Profits to Average Capital Stock

PERCENTAGE INCREASES OVER PREVIOUS YEAR:

Physical Property at end of period
Telephone Revenue
Telephone Expense (as reported)
Net Telephone Earnings (as reported)
Company Stations at end of period
Company and Connecting Station at end of period
Miles of Owned Wire at end of period

PER STATION EARNINGS AND EXPENSES:

(Averages per Month)

Exchange Revenue
Toll Revenue
(Toll Rev. A. T. and T. and Associated Companies)
Total Telephone Revenue
Operation
Current Maintenance
Depreciation (as reported)
Taxes
Total Telephone Expenses
Net Telephone Earnings (as reported)

EXCHANGE AND TOLL REVENUE PER 100 POPULATION:

(Averages per Month)

Exchange Revenue
Toll Rev. A. T. and T. and Associated Companies
Total

PLANT PER STATION:

At end of period
December 31, 1912

STATIONS AND WIRE MILEAGE PER 100 POPULATION AT END OF PERIOD:

Company Stations
Connecting Stations
Total Company and Connecting Stations
Per cent Company and Connecting of all Stations
Wire-Mileage Owned

The foregoing report is also used in any one company to compare one month with previous months or previous periods, thus showing improvements or decline in efficiency. To make the more significant items readily available for reference, it is our practice to make up certain small charts of a size that can be carried in the pocket which present graphically some of the results that appear on these Statistical Unit Reports for a period of months and years. It is thus possible to have at hand in a compact form the main facts about any one company or the entire system.

Special administrative statistics. It is part of the duty of a statistician to be constantly in contact with other departments of the business and to be on the alert for any new interesting point of view that would show more clearly than before some particular

phase of the business which could be improved or changed to advantage. For example a chart [is prepared which] compares the disposition of Gross Revenues in various telephone companies and divisions.

So far I have talked mostly about the direct administrative work. It is obvious, however, that in a business as large as the Bell Telephone System needs for special reports or special information for use before Government bodies or for the public press, or for our own general information, are innumerable. A table such as the following is of interest in showing to a Public Service Commission or to the public in general that telephone rates have gone down while the service furnished has increased.

Bell Telephone System in the United States

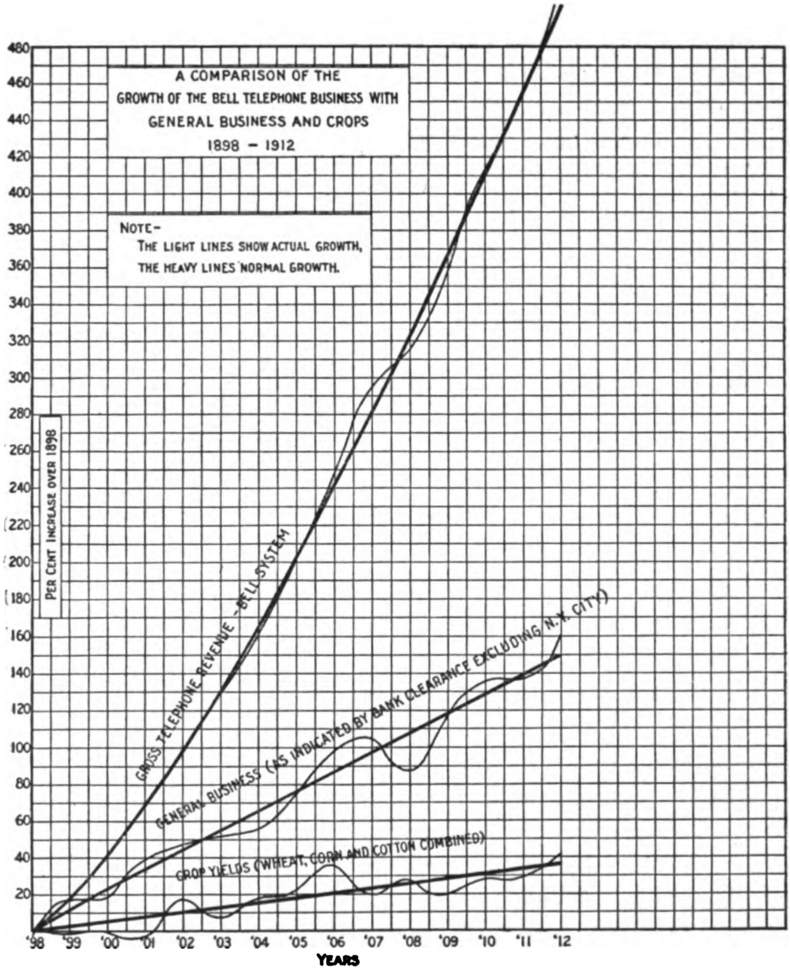
	1895	1900	1905	1910	1912
Average exchange rates....	$69.75	$44.68	$33.31	$31.28	$30.93
Average number of subscribers per exchange....	172	276	490	782	957

General administrative statistics. In order that an executive may have the broadest possible outlook, it is necessary constantly to correlate the telephone business with outside activities. A chart, for instance, has been made up to show how general business is running from month to month as compared with normal business. If the telephone business should begin to fall off greatly when general business is good or improving, this would give us the signal to investigate the causes.

Somewhat related to the last chart is one which compares the increase in the telephone business with the increase in general business and with crop productions over a period of years.

The chart below is a particularly interesting example of statistical graphics inasmuch as to get a true comparison we have departed from actual figures but with their use have made up imaginary "normal" figures which may be compared at any year and which will give a much more truthful idea of the comparative growth than the actual figures could possibly do. In the chart

the light lines are plotted from the actual figures and the heavy lines from the normal figures. The diagram is also remarkable for showing the great steadiness of the telephone business as



compared with the others, the actual and the normal curves being almost coincident.

Originating new statistics. In addition to the foregoing work done under the direct supervision of the Statistician, there is an additional duty which falls upon him, due to the fact that his

position is a general staff position. It is not only his duty to compile statistics which should be compiled periodically and permanently under his jurisdiction, but also under certain conditions to do pioneer work that may later belong to some one of the operating departments of the business.

For instance — several years ago the Statistical Department of the Bell System started records on telephone rates in effect in all Bell exchanges of the country. After the statistical forms had been devised and the records obtained for the first time, this work was then turned over to the Commercial Department.

A year ago data was collected on all of the 200,000 employees of the system with a view of estimating the cost of certain benefit plans which were then under consideration and later adopted. Now we are busy in connection with these plans in building up statistical records which will enable us to study occupational diseases, if any, and causes of accidents. Information must be provided as a basis for determining the probable cost of the plan in the future or the cost of any changes which may appear desirable from time to time. Whether this work will be so specialized and grow to such a size that it will be advisable to have it in a department by itself remains to be seen. At any rate the work of first devising the statistical methods and putting the statistical plans in operation is the duty of the Statistician.

The statistical work done in the Bell Telephone System has been only touched upon. A description of statistical methods or a detailed analysis of the valuable results obtained from the various statistical charts and tables has not been attempted. Simply the function of statistics and the duty of the Statistician in the business have been described. Statistical work constantly requires imagination coupled with reason, a continual search for new items of interest, new sources of information, and better or clearer methods of presentation.

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